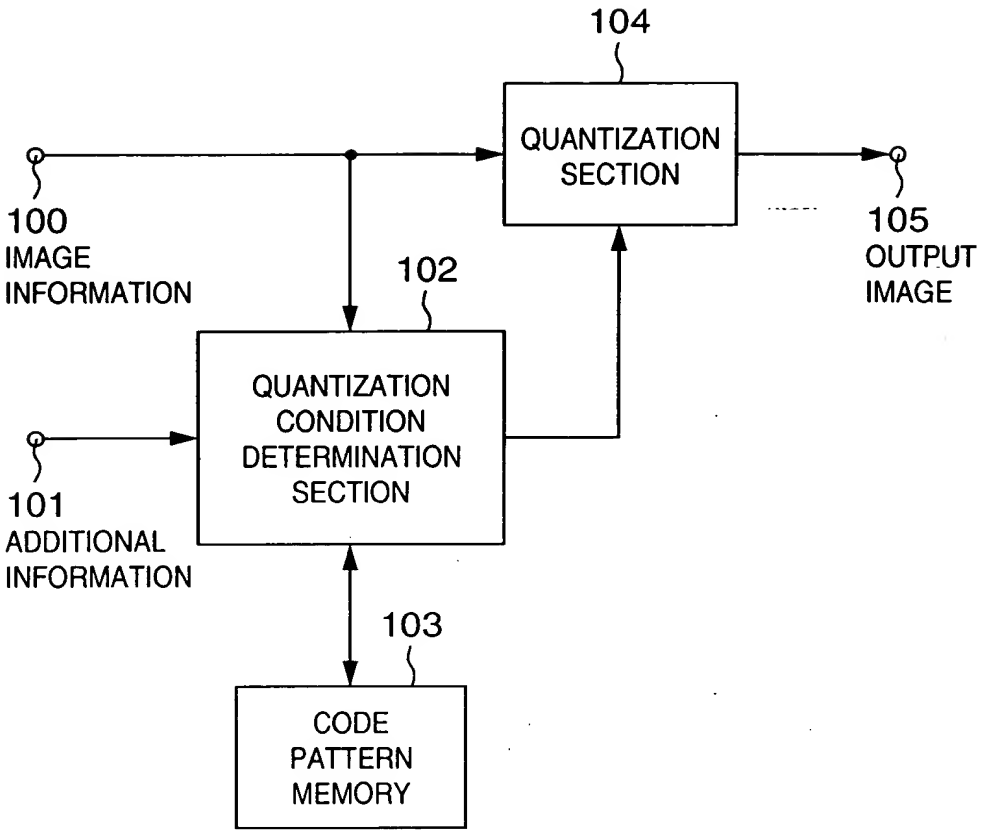
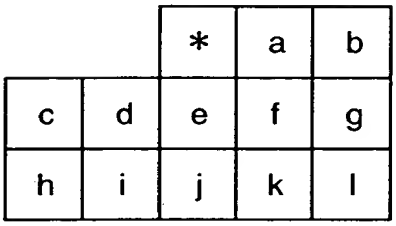
FIG. 1



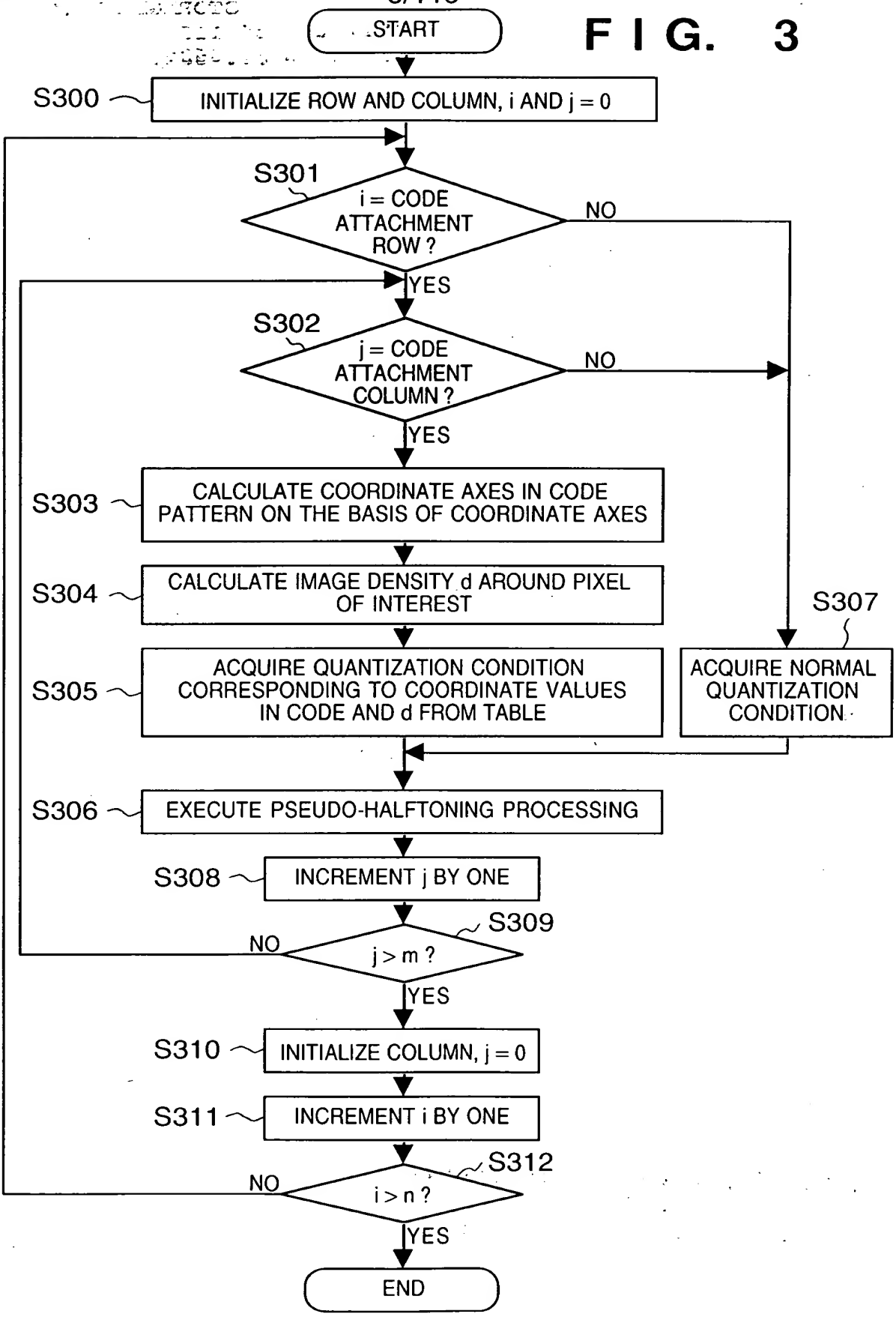
0082609 "EP 1 596 7960

FIG. 2



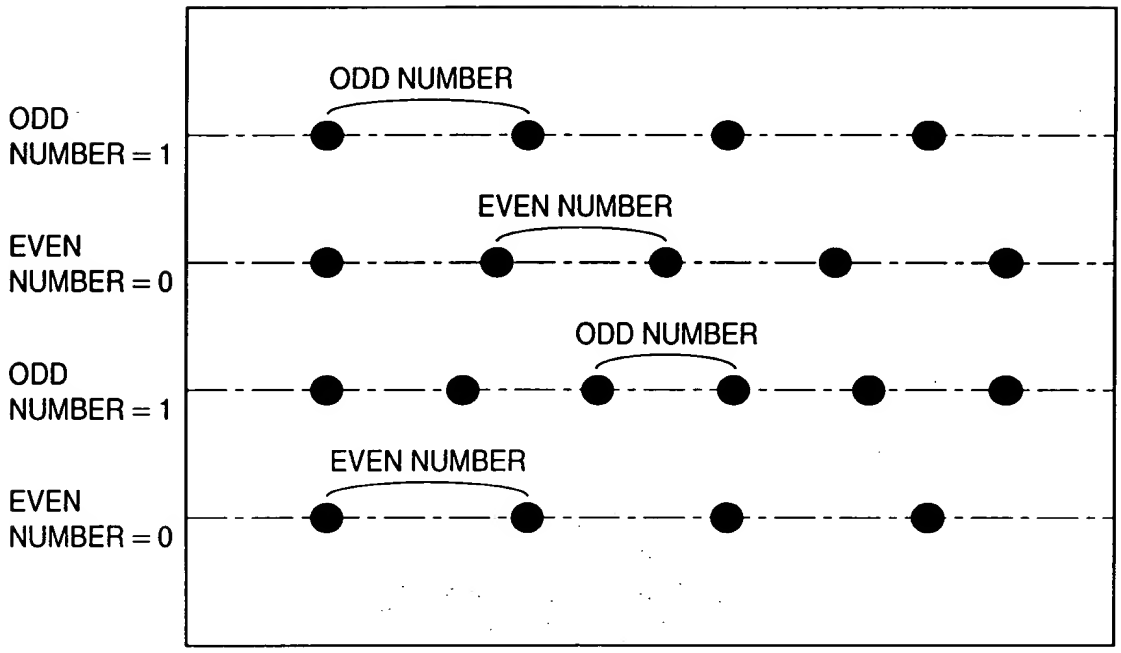
09967523 .092800

FIG. 3



0096 1529 0960 0800

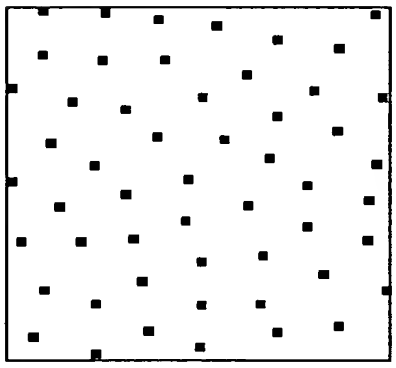
FIG. 4



0967162 3.092800

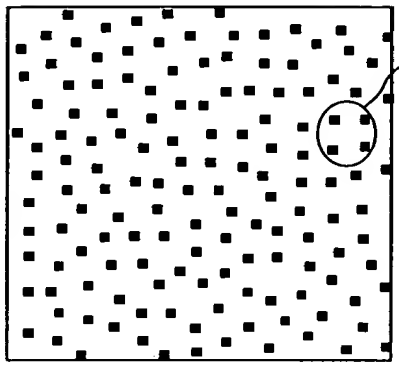
WO 96/23960 PCT/US96/00800

FIG. 5A



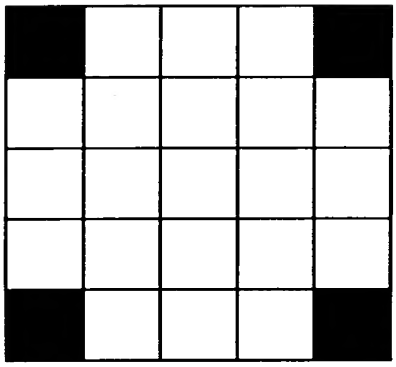
DENSITY 5/256

FIG. 5B



DENSITY 15/256

FIG. 6



0096/23456 0082800

FIG. 7

X	Y	Y	Y	X
Y	Y	Y	Y	Y
Y	Y	Y	Y	Y
Y	Y	Y	Y	Y
X	Y	X	X	X

0082609 '6297960

FIG. 8B

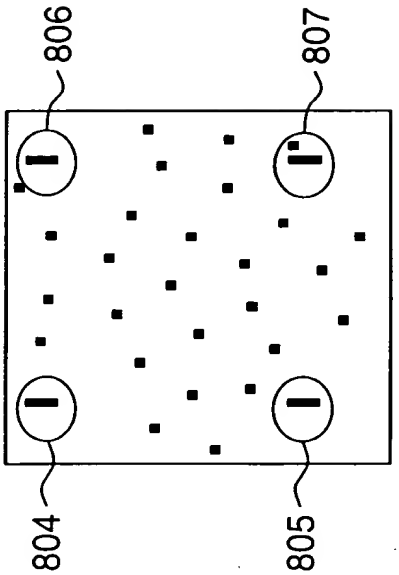


FIG. 8A

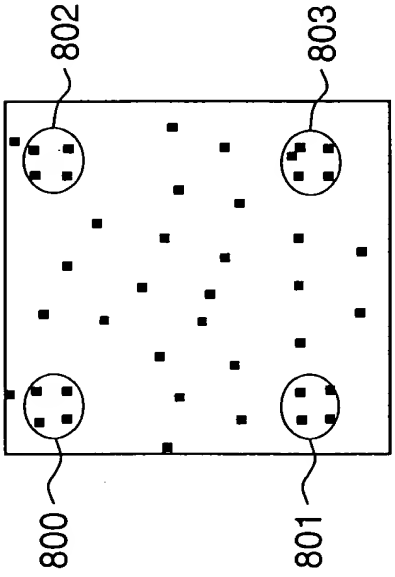
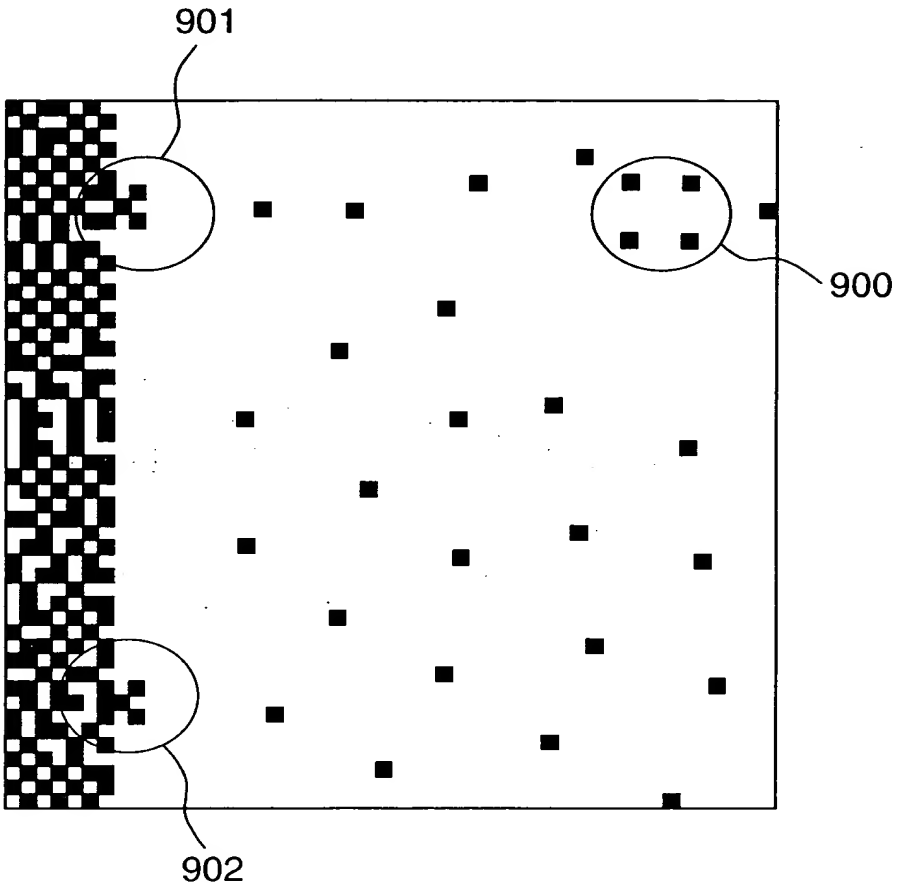
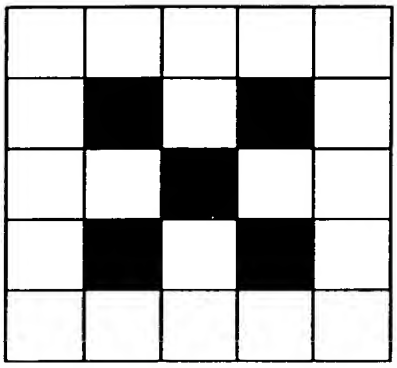


FIG. 9



WO 96/27960 PCT/US96/02860

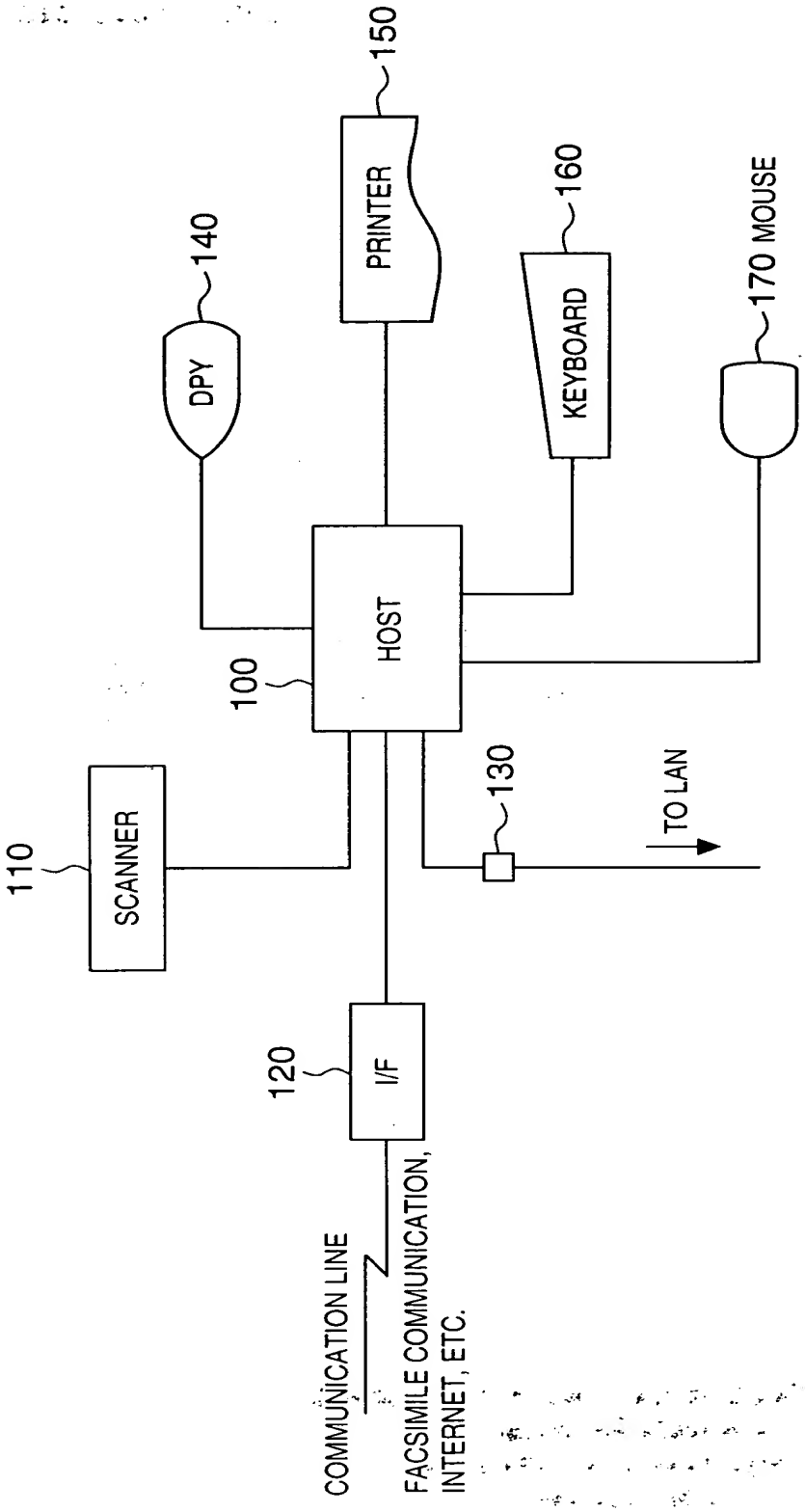
FIG. 10



0082600 "E29T4960

0082601 E291960

FIG. 11



096716230.008260

FIG. 12

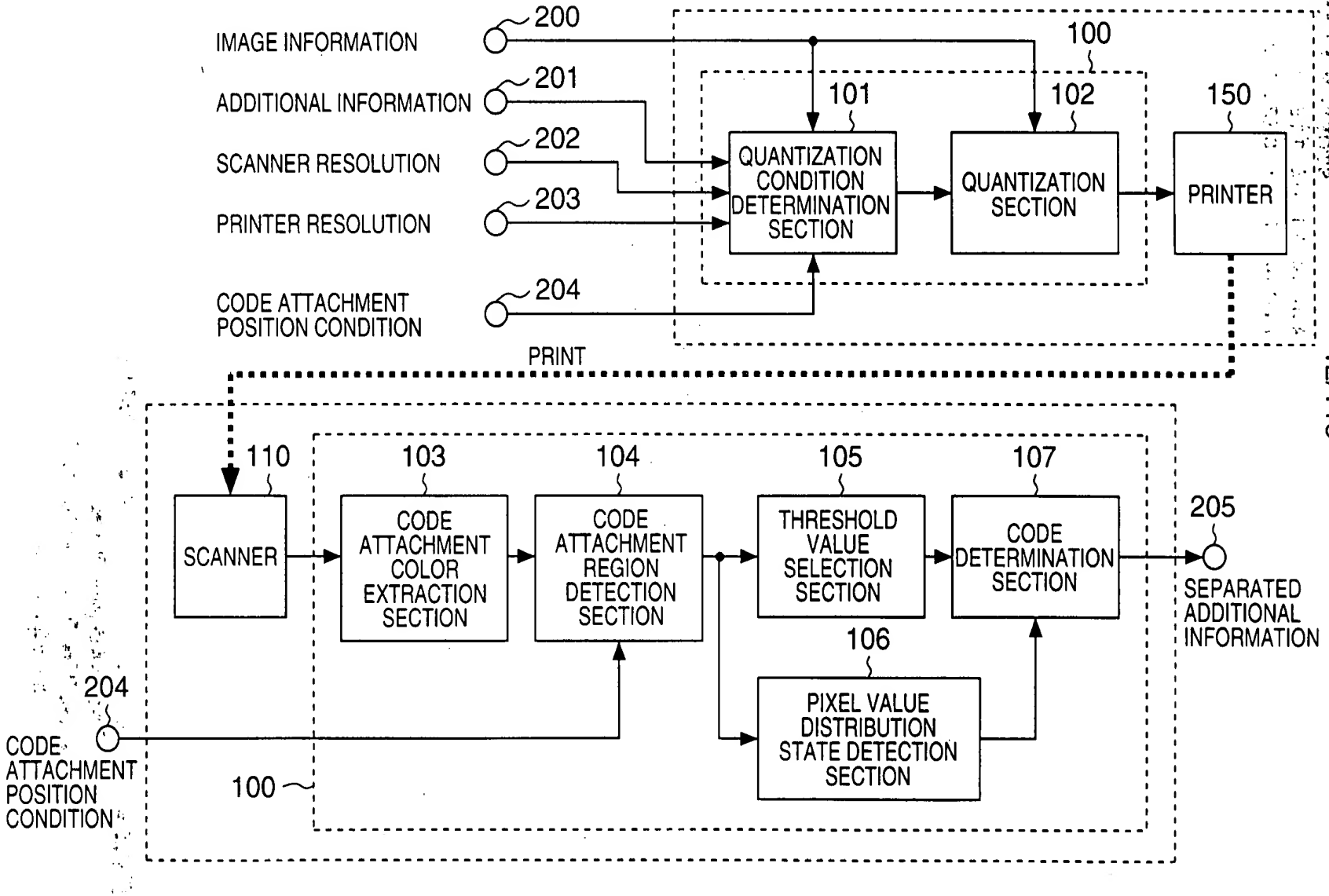
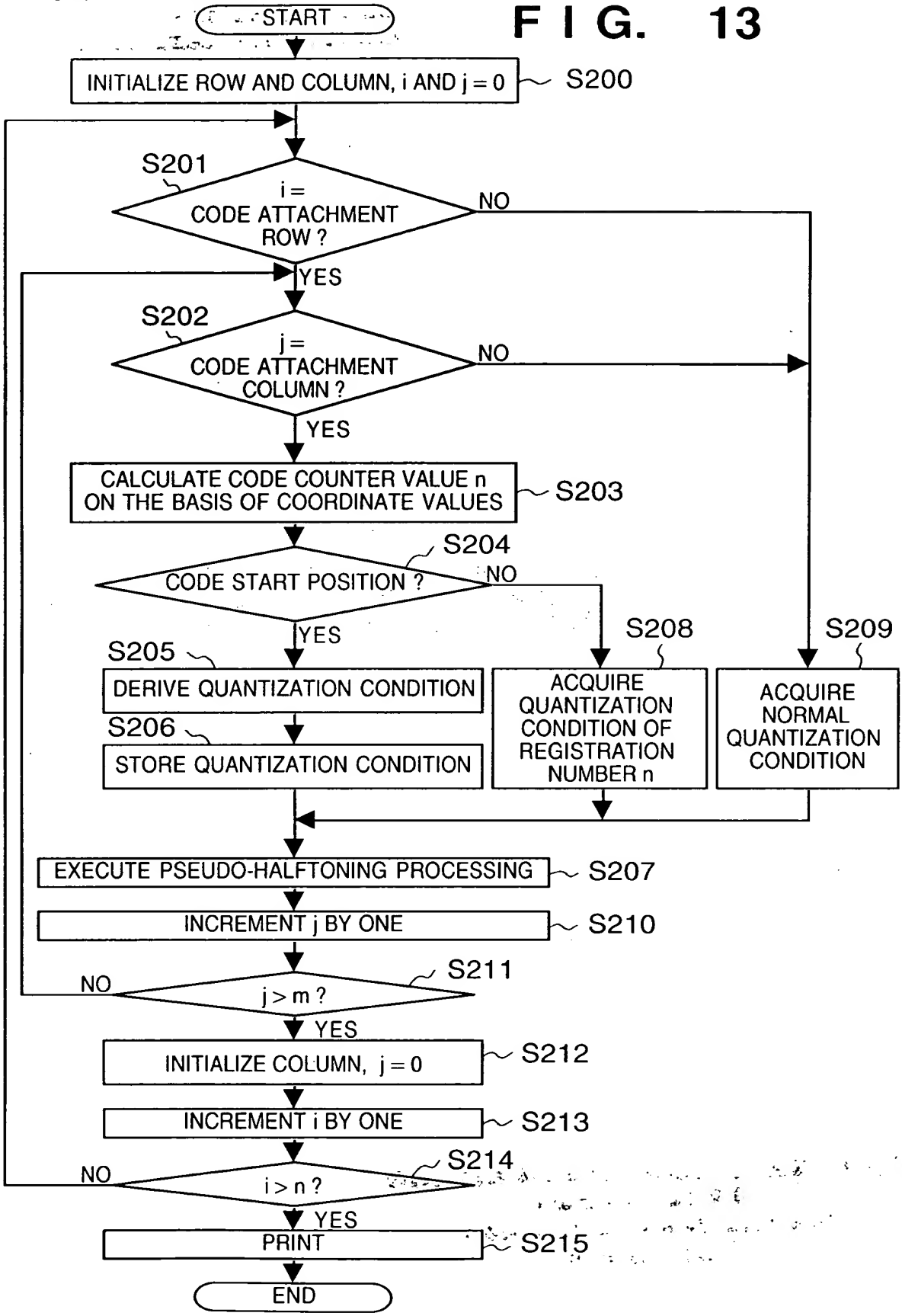
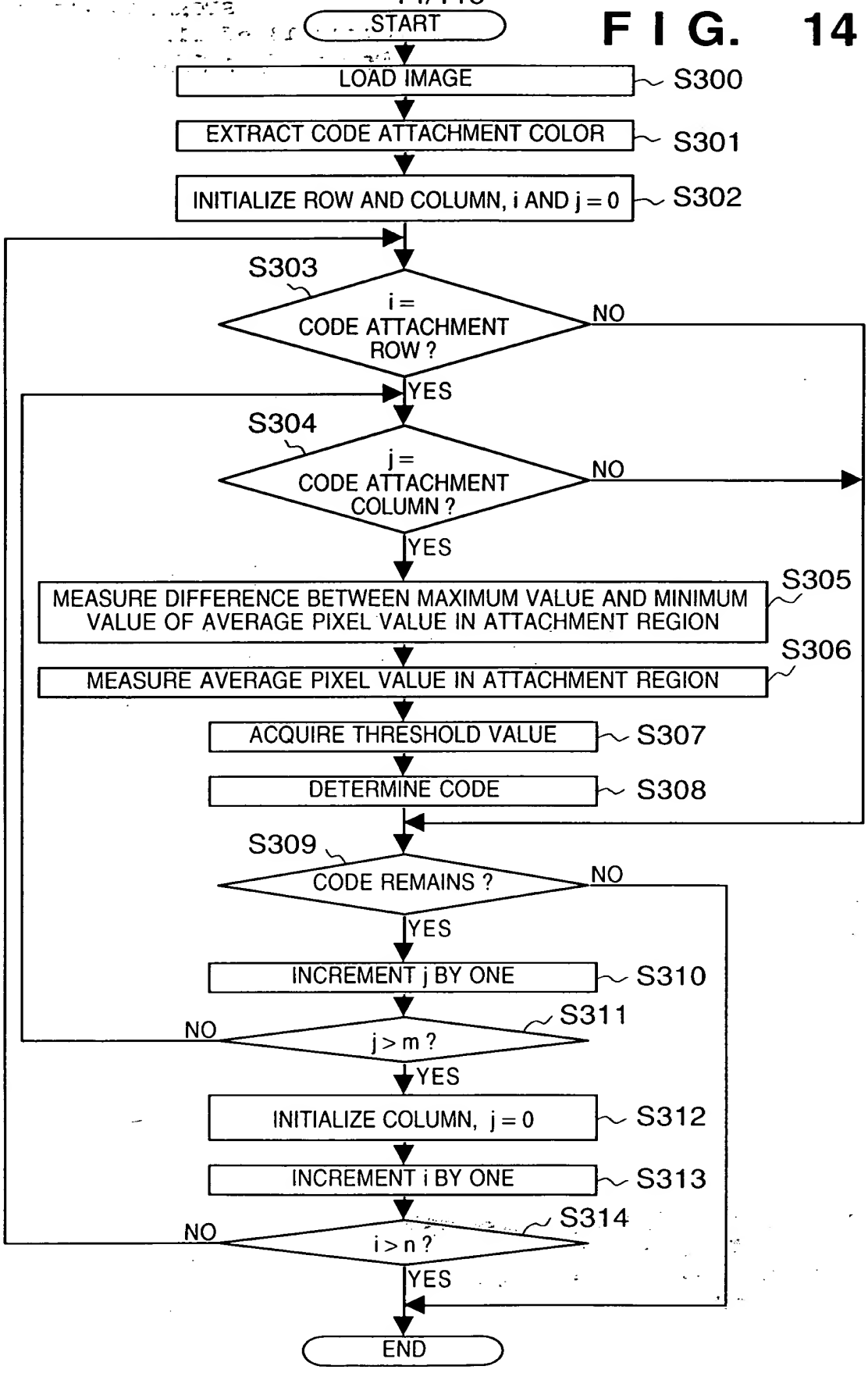


FIG. 13



0082601 E29T7960

FIG. 14



0096723 '0928000

FIG. 15A

128	128	128	128	128	128	128	128
128	128	128	128	128	128	128	128
128	128	128	128	128	128	128	128
128	128	128	128	128	128	128	128
128	128	128	128	128	128	128	128
128	128	128	128	128	128	128	128
128	128	128	128	128	128	128	128
128	128	128	128	128	128	128	128

FIG. 15B

255	0	255	0	255	0	255	0
0	255	0	255	0	255	0	255
255	0	255	0	255	0	255	0
0	255	0	255	0	255	0	255
255	0	255	0	255	0	255	0
0	255	0	255	0	255	0	255
255	0	255	0	255	0	255	0
0	255	0	255	0	255	0	255

FIG. 15C

0	255	0	255	255	0	255	255
255	0	255	0	0	255	0	0
255	0	0	0	0	0	255	255
255	255	255	0	0	0	255	0
0	255	255	255	255	255	255	0
0	255	0	0	0	255	0	255
255	0	255	255	0	255	0	255
0	0	255	0	255	0	255	0

401
QUANTIZATION VALUES WHICH APPEAR TO MAINTAIN DENSITY

400
ARTIFICIALLY GENERATED QUANTIZATION VALUES

008260 "E29T7960

FIG. 16

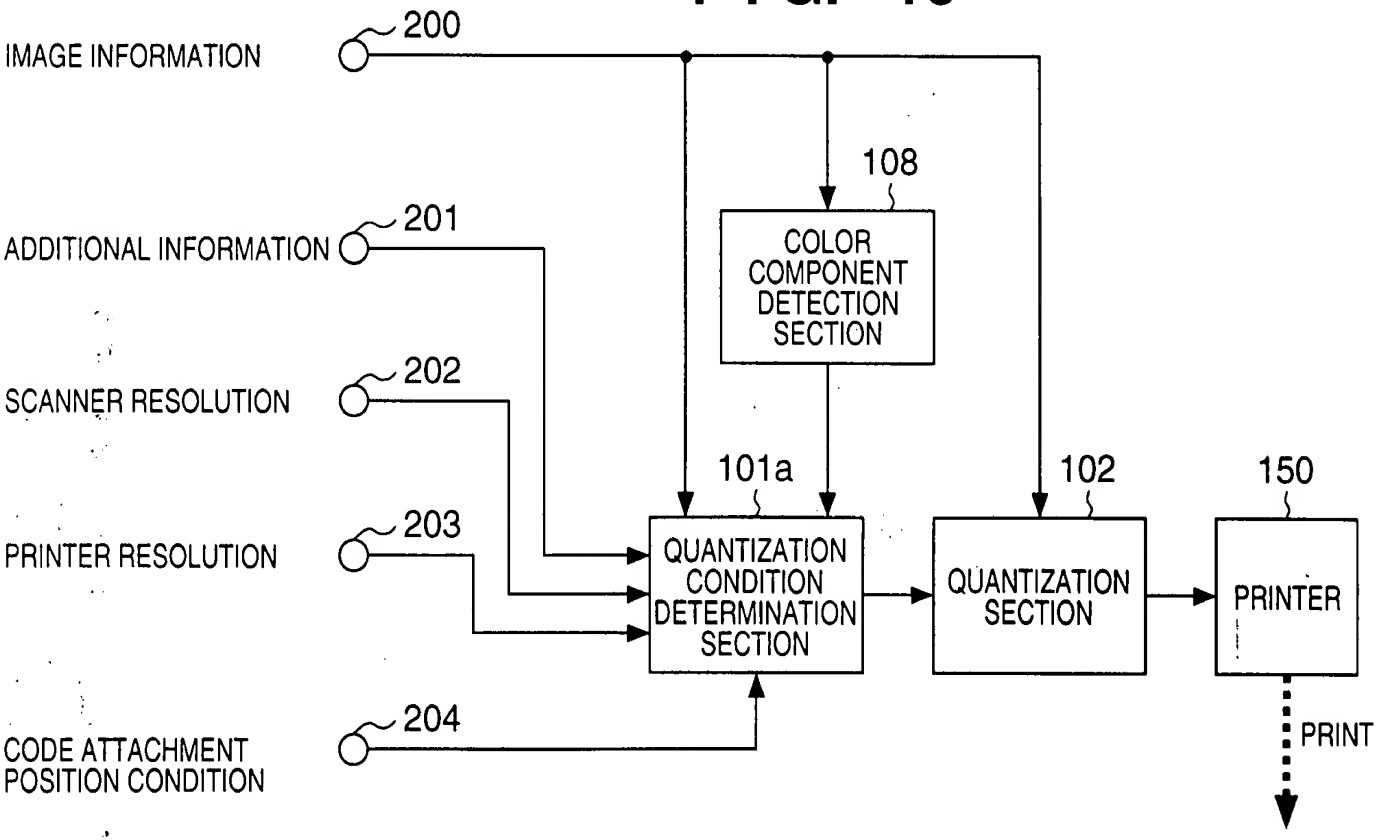
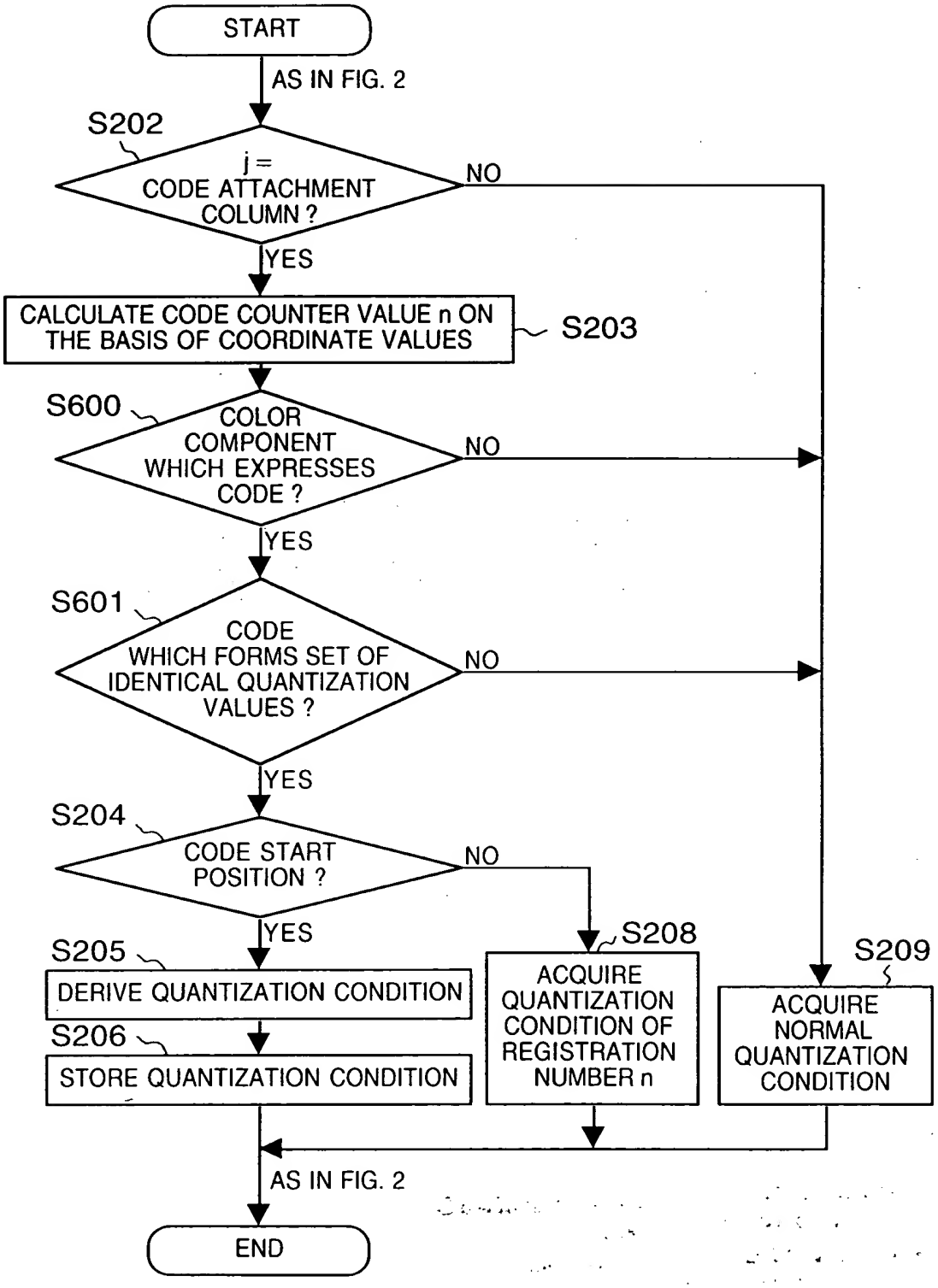


FIG. 17



0082601 · 5297960

FIG. 18

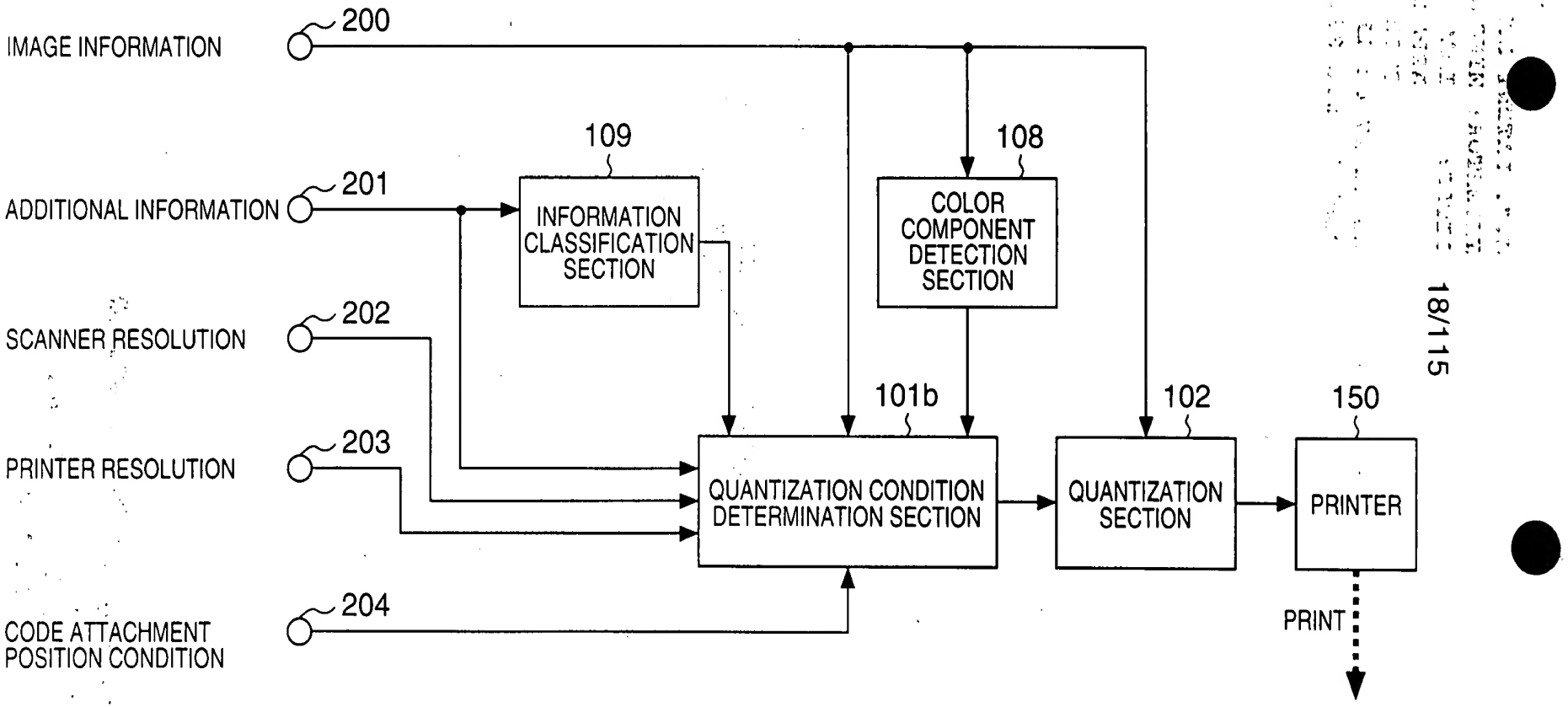
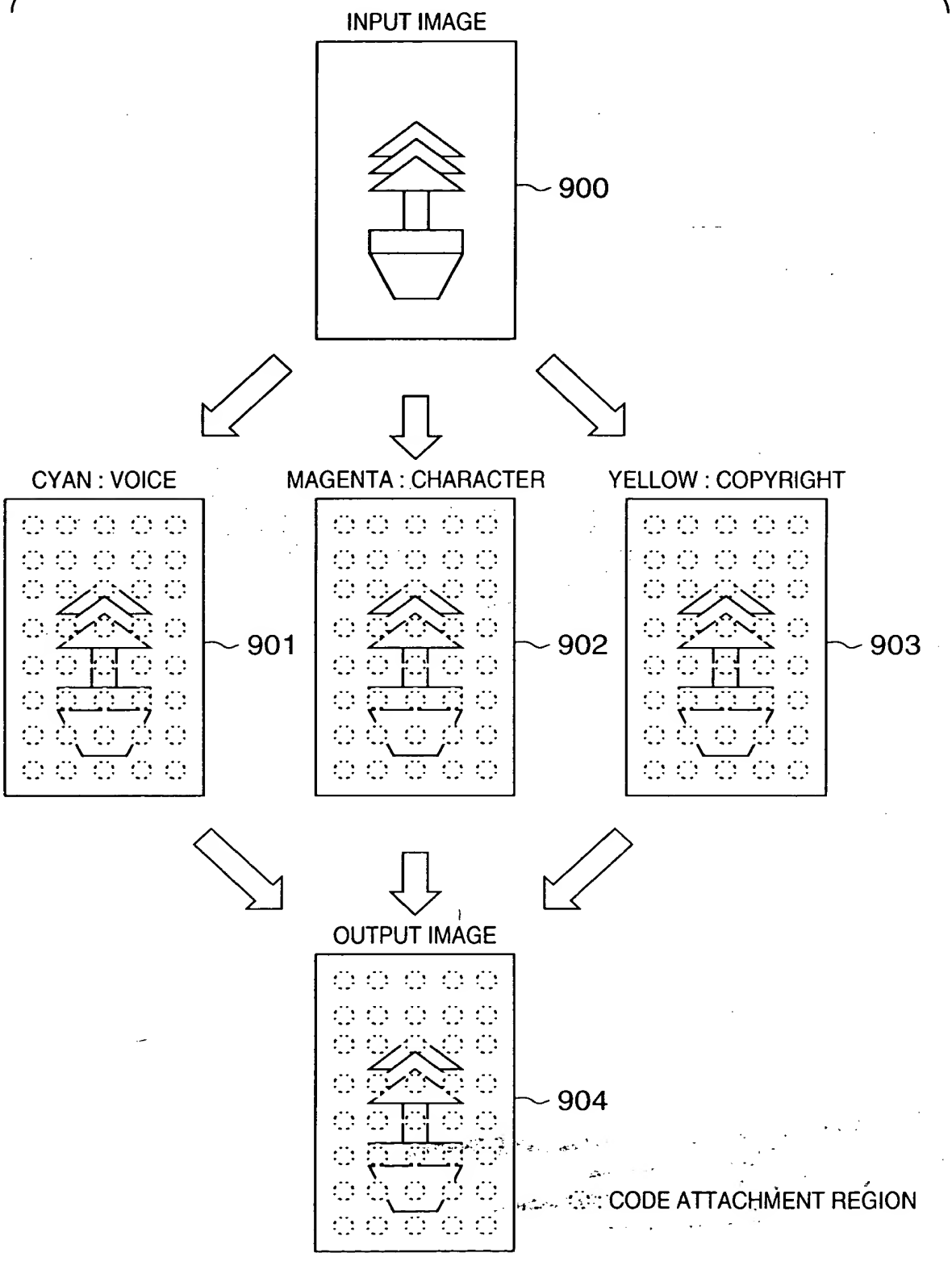


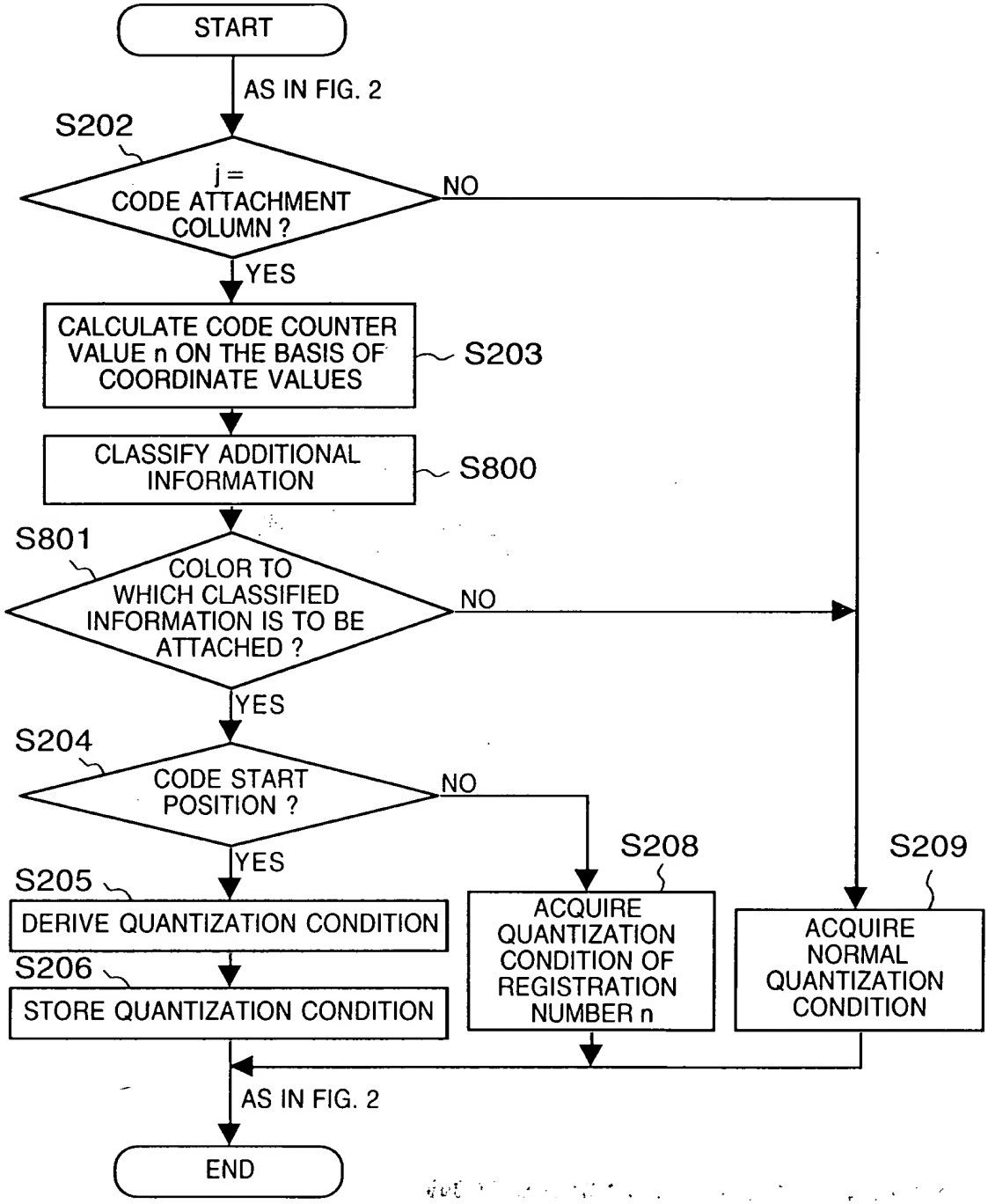
IMAGE INFORMATION
200
ADDITIONAL INFORMATION
201
SCANNER RESOLUTION
202
PRINTER RESOLUTION
203
CODE ATTACHMENT POSITION CONDITION
204
109
INFORMATION CLASSIFICATION SECTION
108
COLOR COMPONENT DETECTION SECTION
101b
QUANTIZATION CONDITION DETERMINATION SECTION
102
QUANTIZATION SECTION
150
PRINTER
PRINT

FIG. 19



0096713 · 0826001

FIG. 20



0096726 "EP1796960

FIG. 21A

a1	a2	a3	a4	a5	a6	a7	a8
a9	a10	a11	a12	a13	a14	a15	a16
a17	a18	a19	a20	X	X	a21	a22
a23	a24	Y	Y	X	X	a25	a26
a27	a28	Y	Y	a29	a30	a31	a32
a33	a34	a35	a36	a37	a38	a39	a40
a41	a42	a43	a44	a45	a46	a47	a48
a49	a50	a51	a52	a53	a54	a55	a56

FIG. 21B

0	255	0	255	255	0	255	255
255	0	255	0	0	255	0	0
255	0	0	225	0	0	255	255
255	0	255	225	0	0	255	0
0	255	255	255	255	0	255	0
0	255	0	0	0	255	0	255
255	0	255	255	0	255	0	255
0	0	255	0	255	0	255	0

1000
REGION HAVING IDENTICAL QUANTIZATION VALUES

1001
REGION HAVING IDENTICAL QUANTIZATION VALUES

FIG. 22

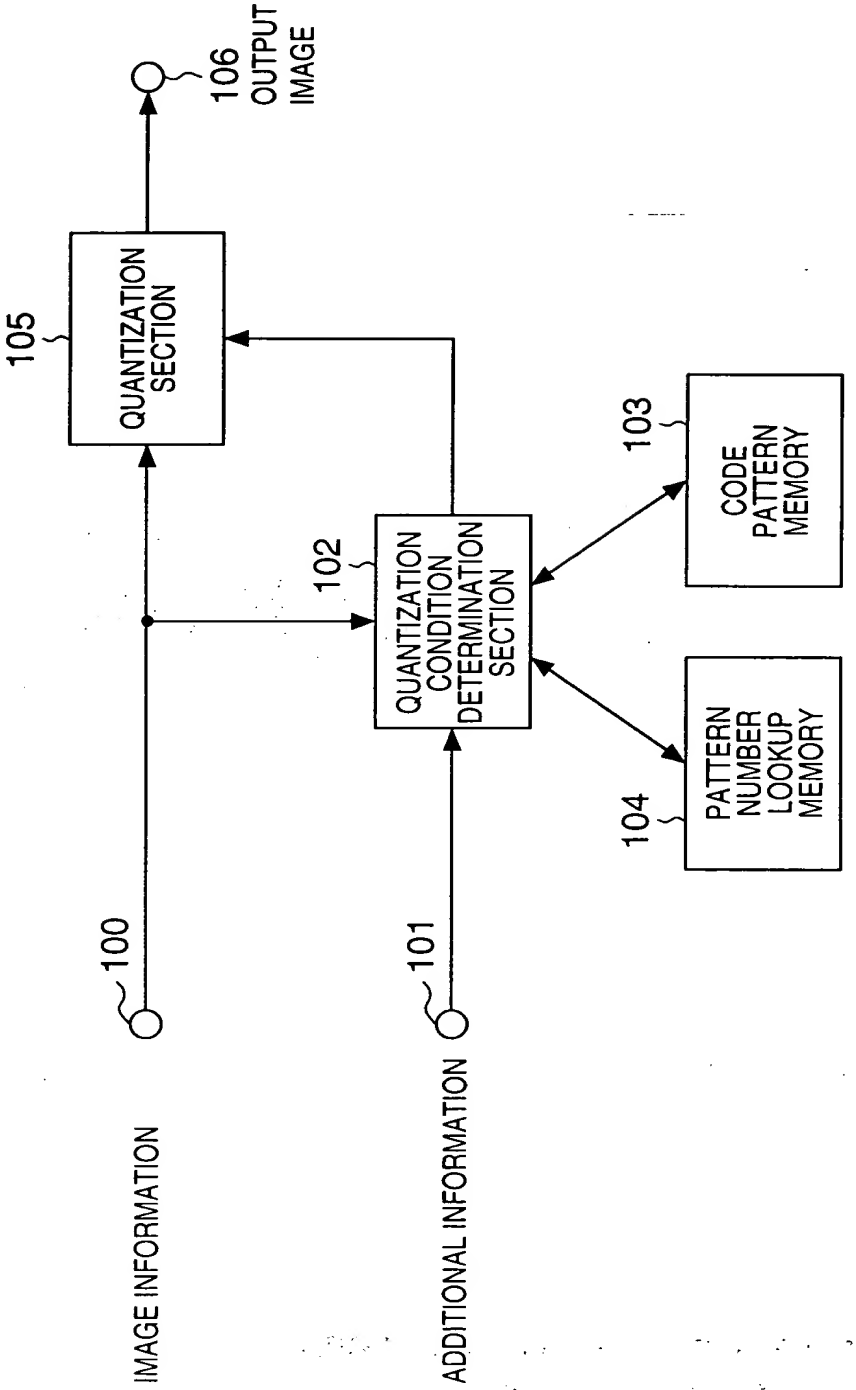


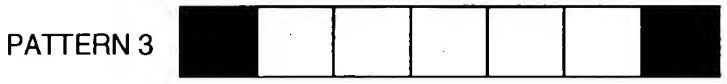
IMAGE INFORMATION
100
ADDITIONAL INFORMATION
101
QUANTIZATION CONDITION DETERMINATION SECTION
102
PATTERN NUMBER LOOKUP MEMORY
104
CODE PATTERN MEMORY
103
QUANTIZATION SECTION
105
106 OUTPUT IMAGE

FIG. 23A

FIG. 23B

FIG. 23C

FIG. 23D



0082609 '09623 7960

FIG. 24A

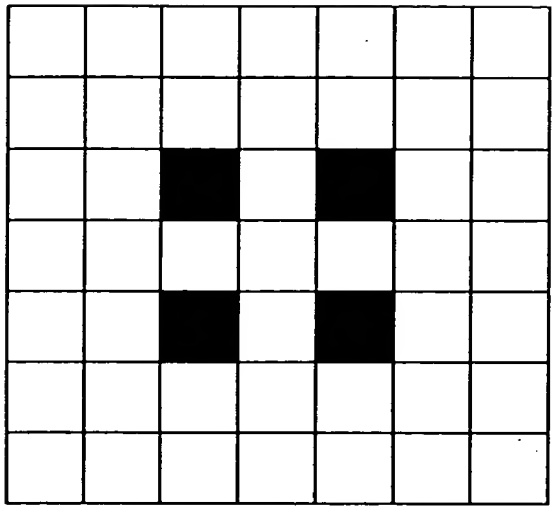


FIG. 24B

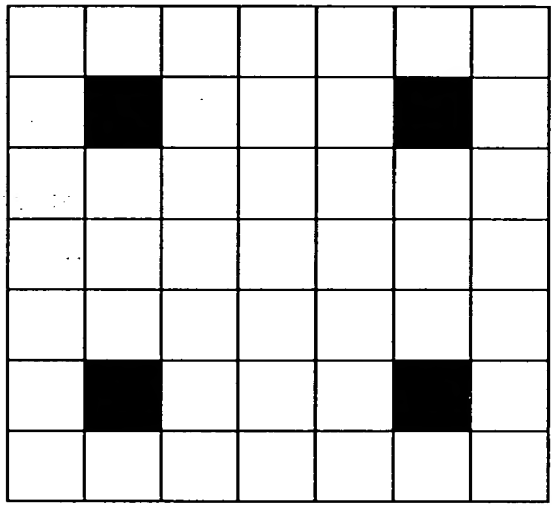
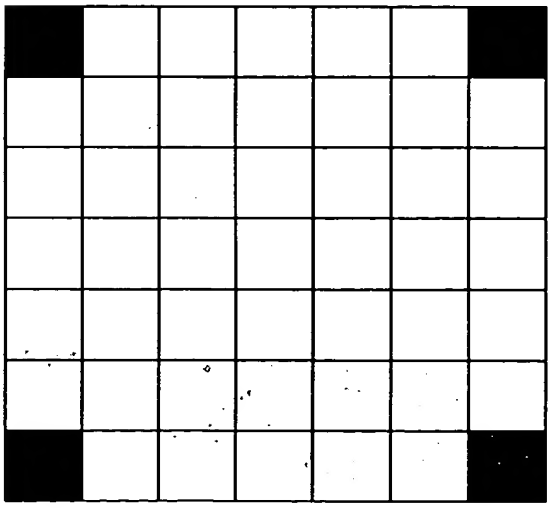


FIG. 24C



09571523 060800

FIG. 25

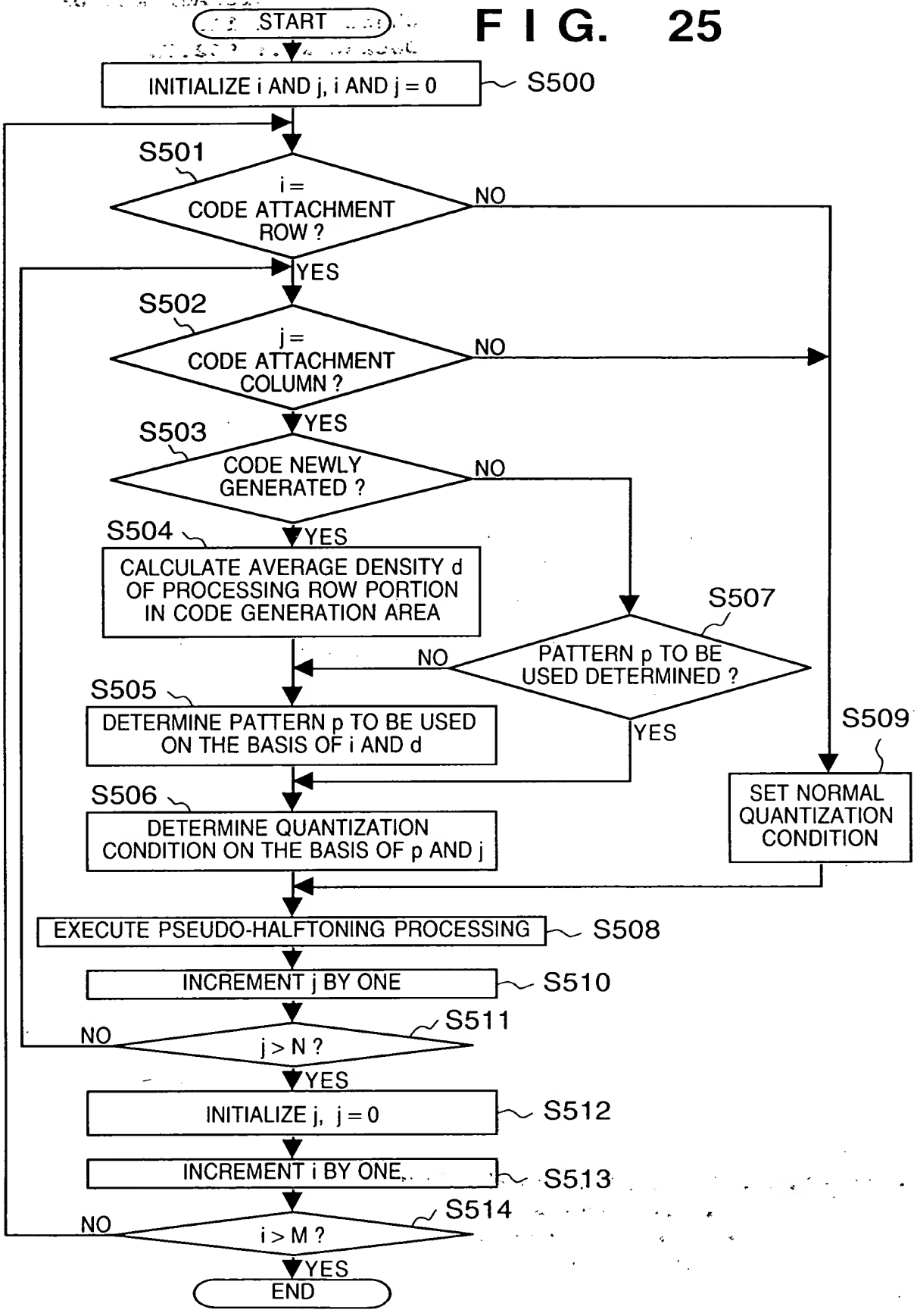

START
INITIALIZE i AND j, i AND j = 0
S500
S501
i = CODE ATTACHMENT ROW ?
NO
YES
S502
j = CODE ATTACHMENT COLUMN ?
NO
YES
S503
CODE NEWLY GENERATED ?
NO
YES
S504
CALCULATE AVERAGE DENSITY d OF PROCESSING ROW PORTION IN CODE GENERATION AREA
S507
PATTERN p TO BE USED DETERMINED ?
NO
YES
S505
DETERMINE PATTERN p TO BE USED ON THE BASIS OF i AND d
S509
SET NORMAL QUANTIZATION CONDITION
S506
DETERMINE QUANTIZATION CONDITION ON THE BASIS OF p AND j
EXECUTE PSEUDO-HALFTONING PROCESSING
S508
INCREMENT j BY ONE
S510
S511
j > N ?
NO
YES
INITIALIZE j, j = 0
S512
INCREMENT i BY ONE
S513
S514
i > M ?
NO
YES
END

FIG. 26A

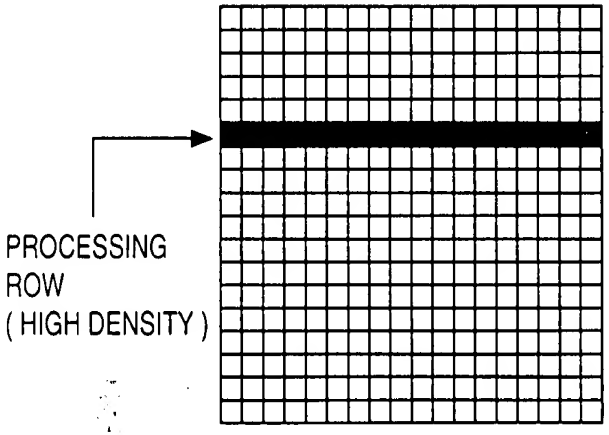


FIG. 26B

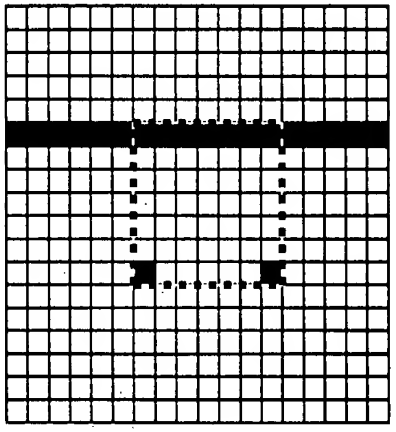


FIG. 26C

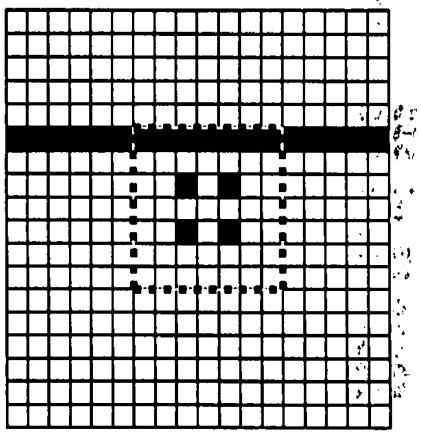


FIG. 26D

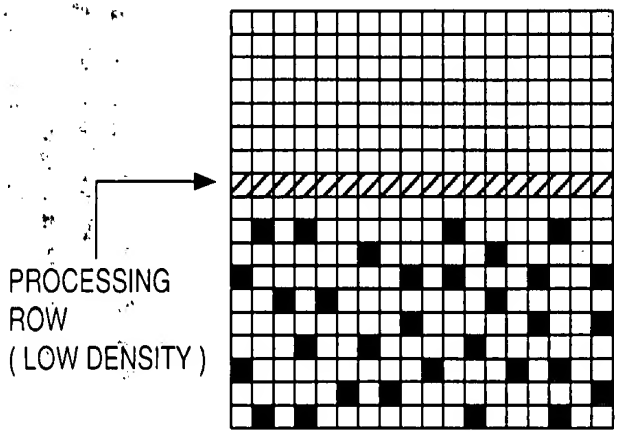


FIG. 26E

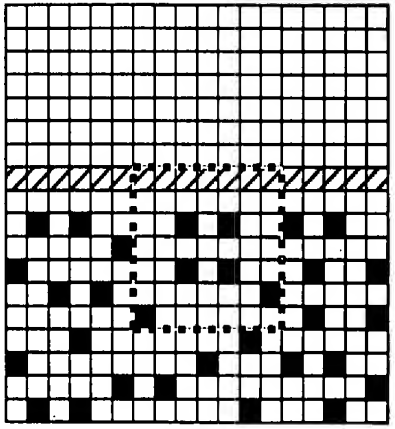


FIG. 26F

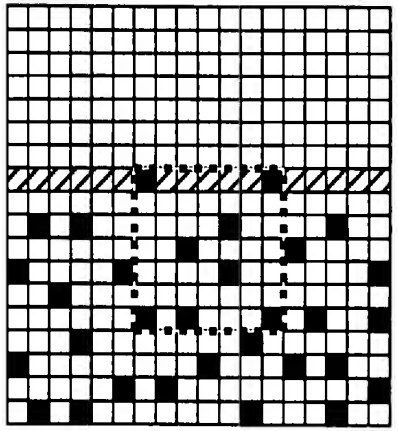


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FIG. 27

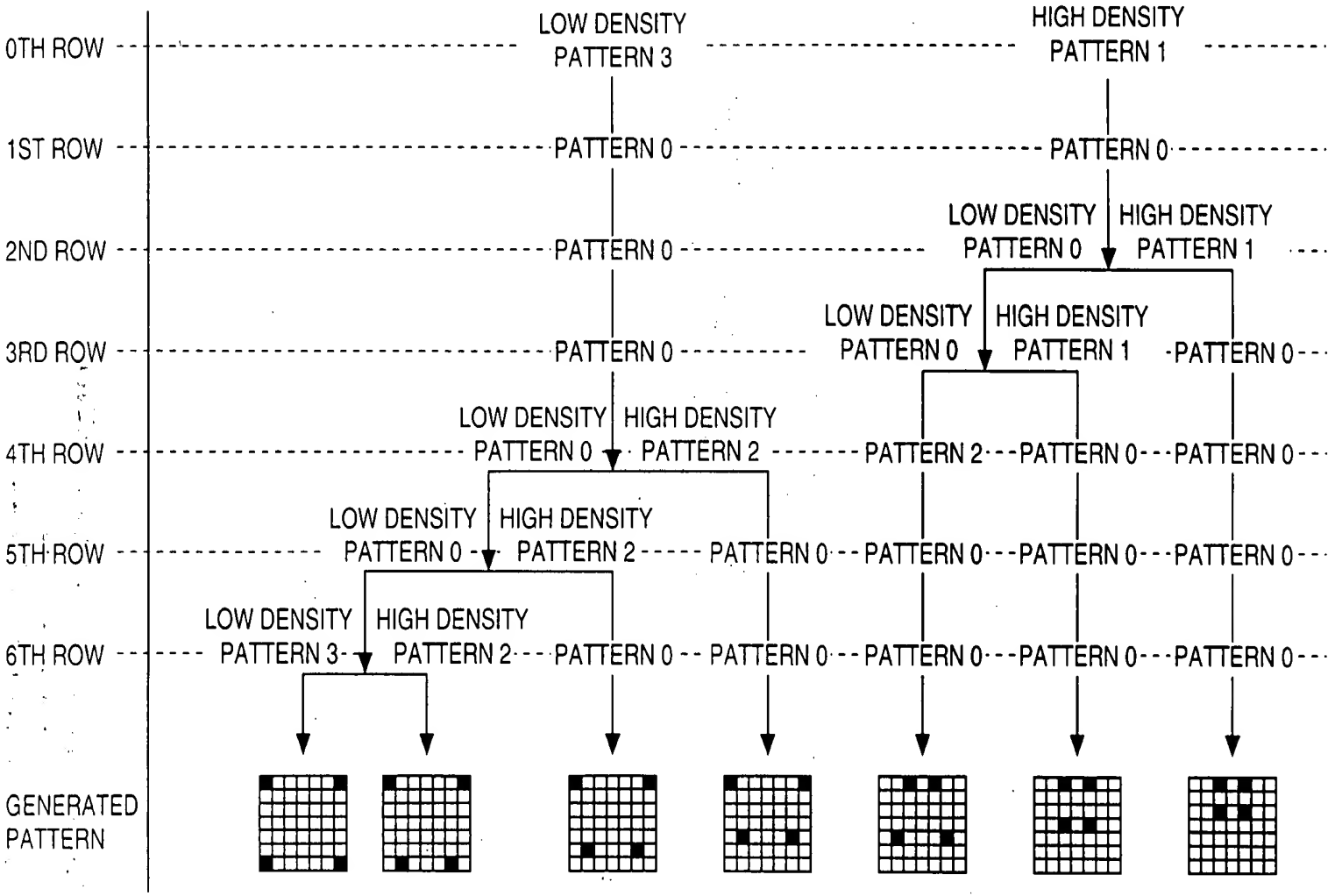
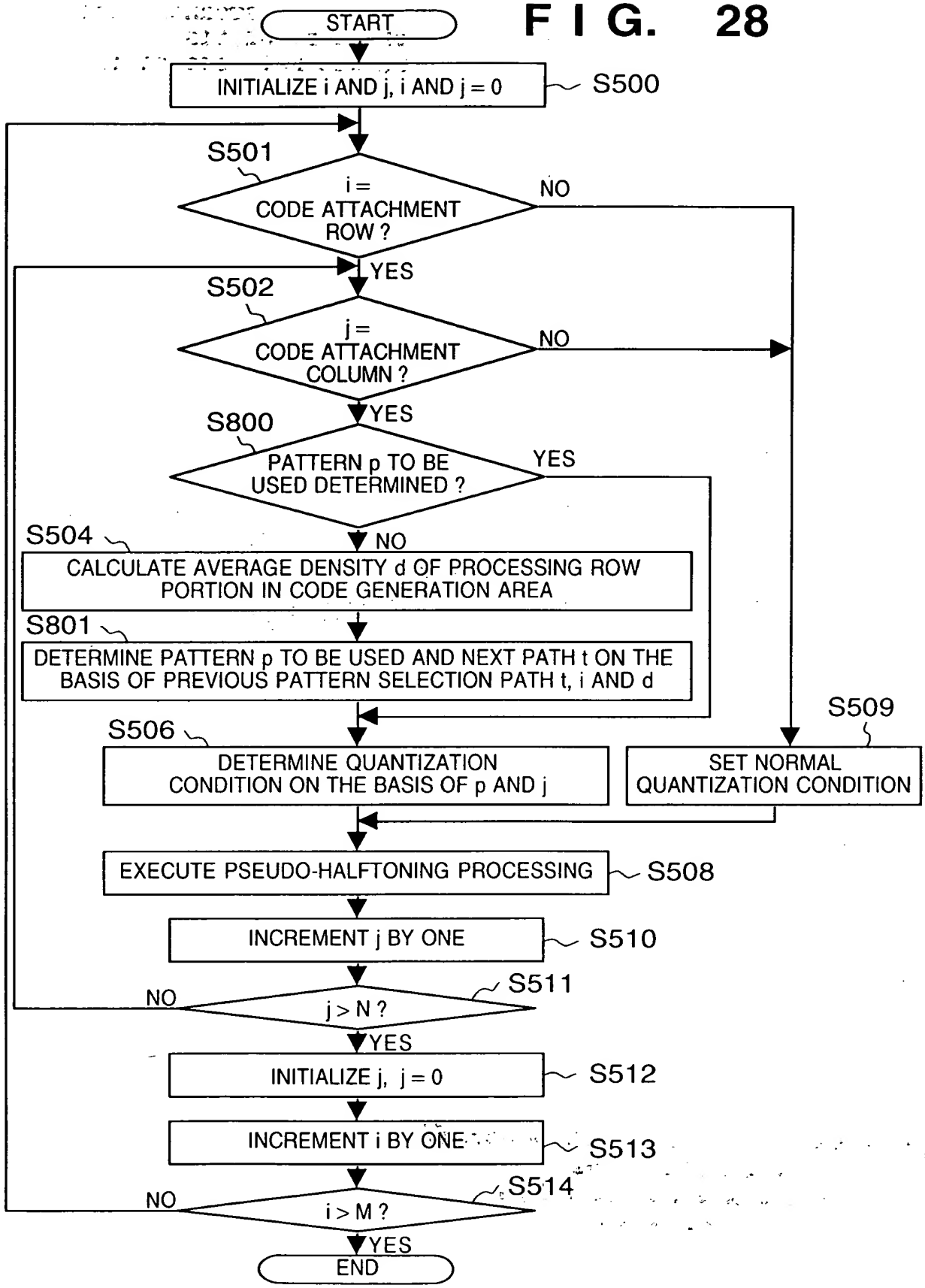


FIG. 28



0956315 0926800

0082601291960

FIG. 29

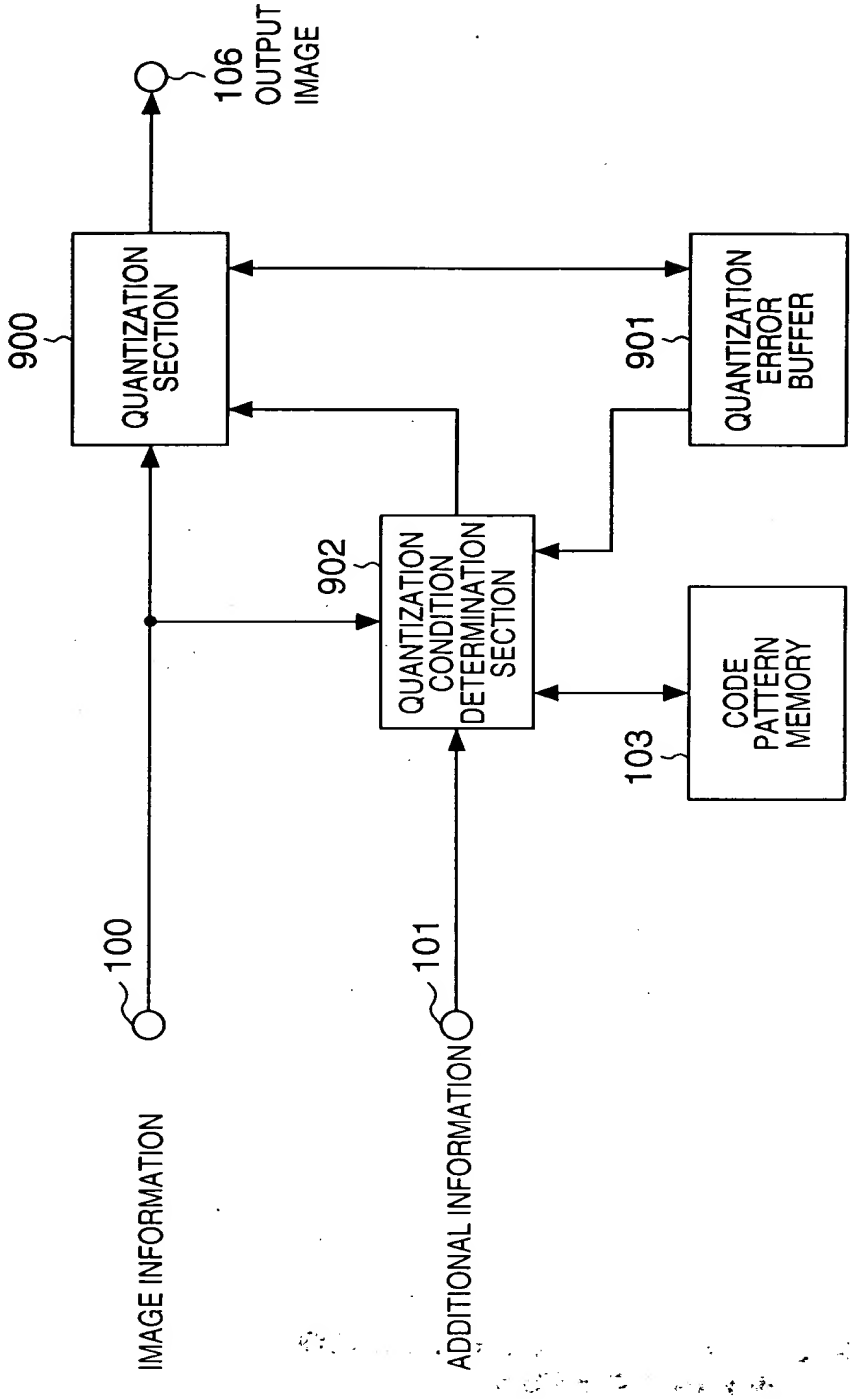


FIG. 30A

LOW-DENSITY REGION

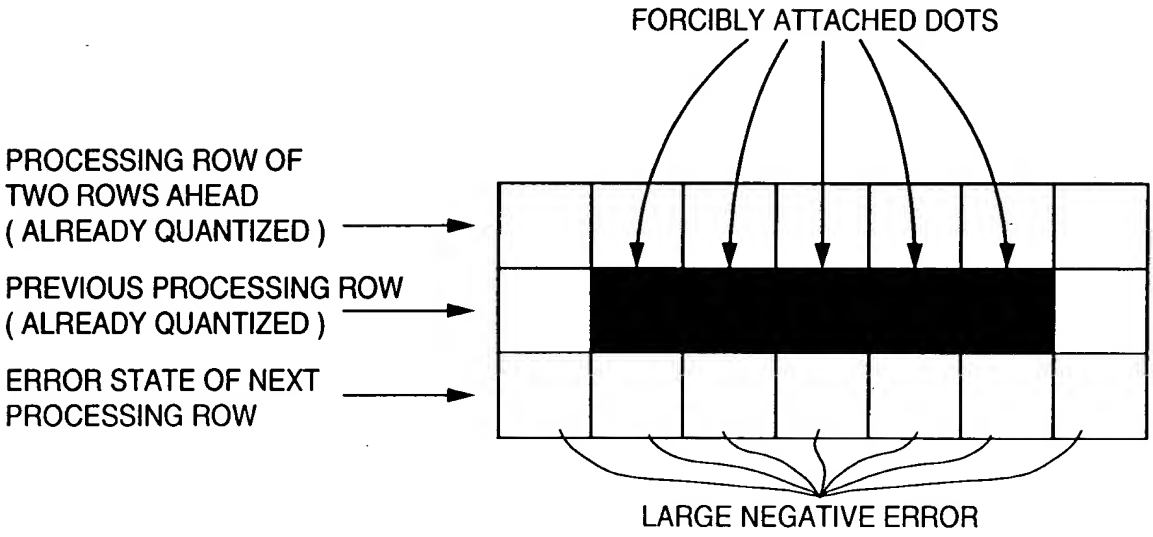
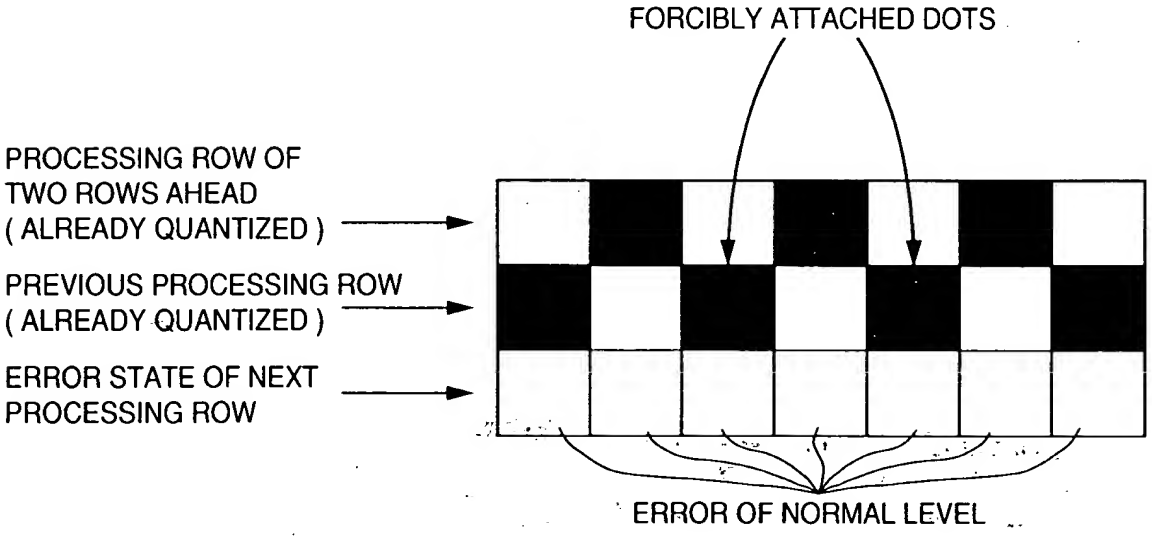


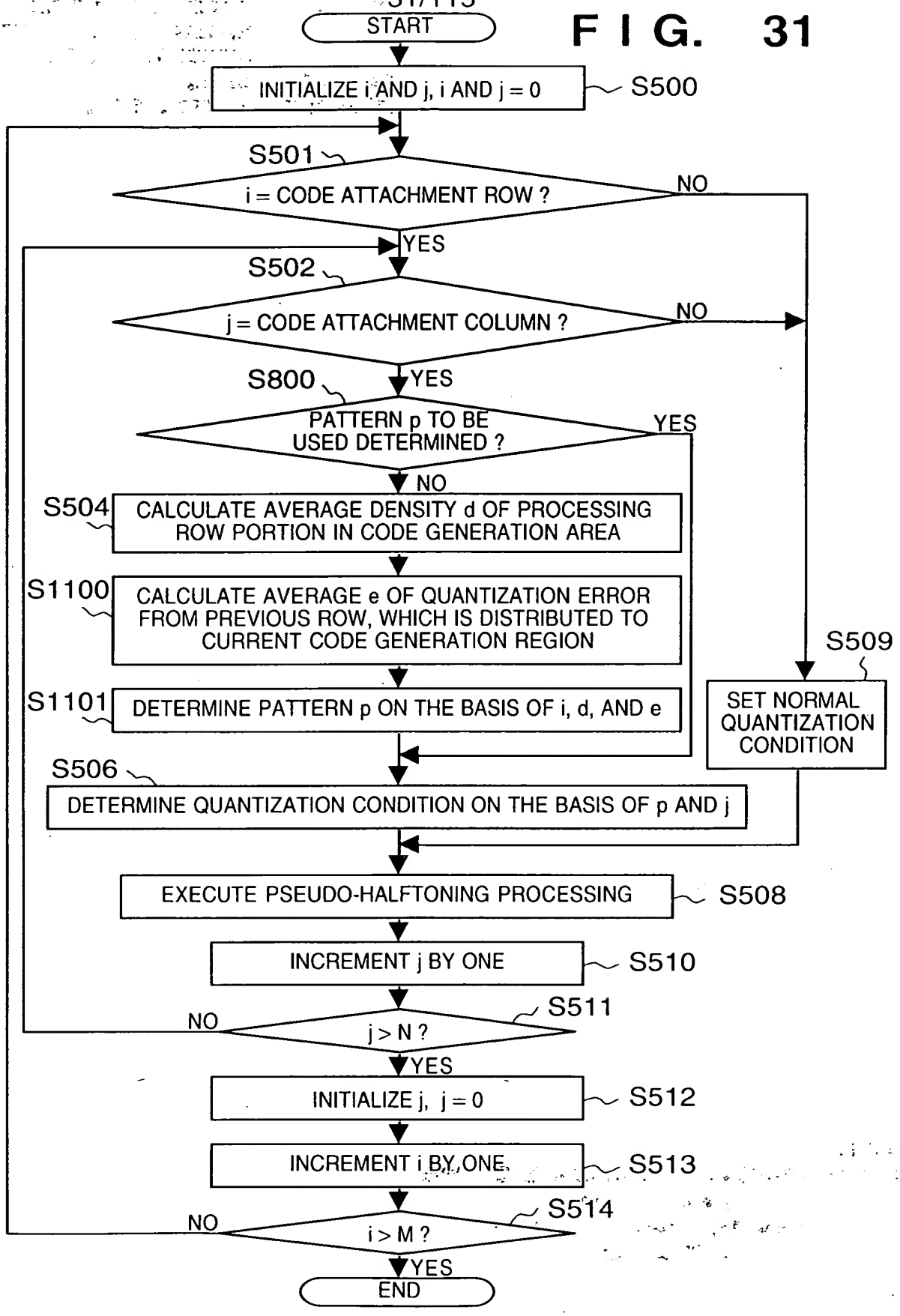
FIG. 30B

INTERMEDIATE-DENSITY REGION



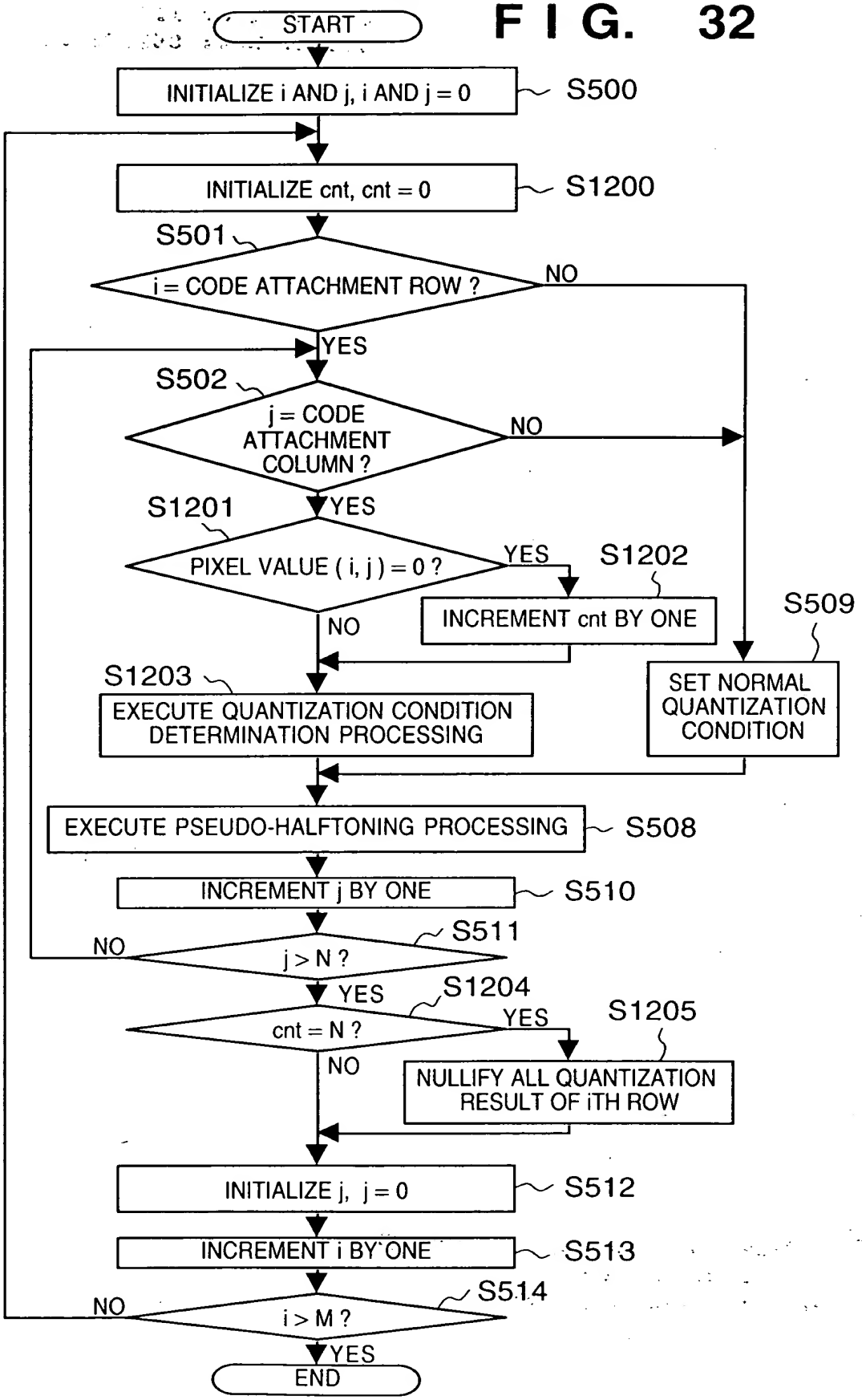
0082609 '23715960

FIG. 31



0008260 "E29F7960

FIG. 32



0080800 '23T5960

008260"E29T/960

FIG. 33

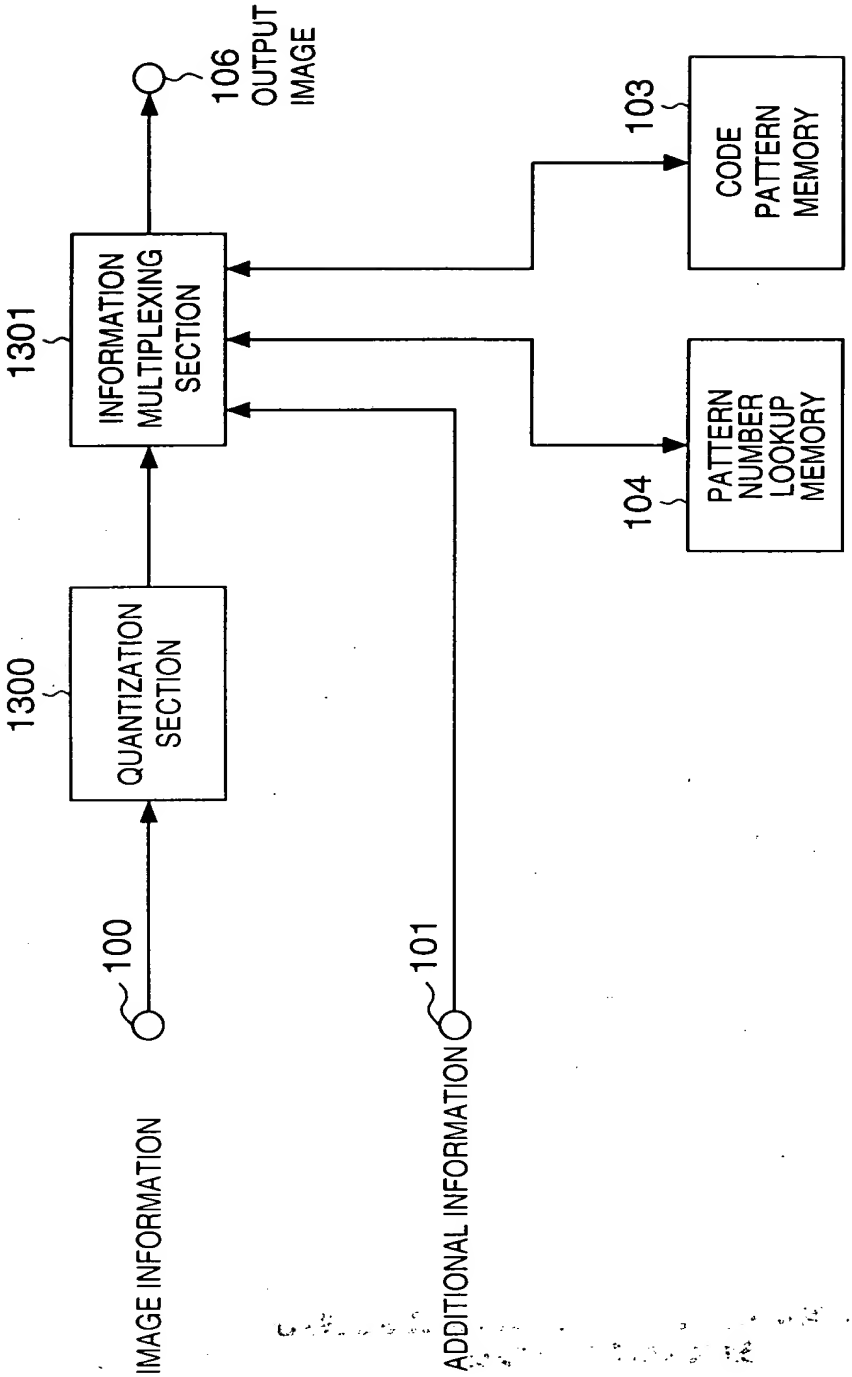
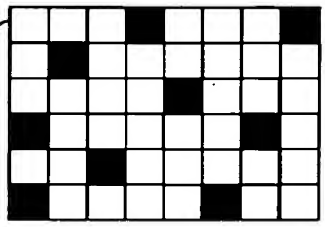
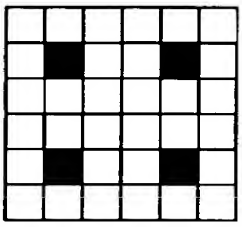


FIG. 34A



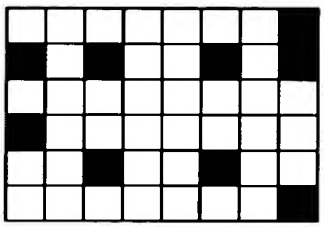
INPUT IMAGE

FIG. 34B



ADDITIONAL PATTERN

FIG. 34C



OUTPUT IMAGE

FIG. 34D

0 0 0 1 0 0 0 1

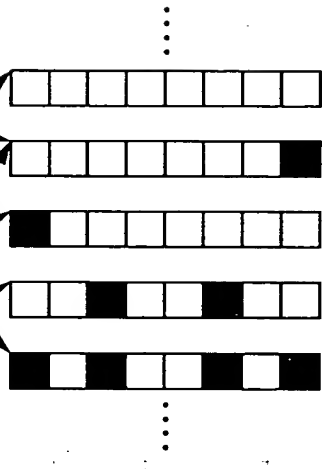
CODE GENERATION REGION START ROW PATTERN

FIG. 34E

PATTERN IDENTIFICATION NUMBER

PATTERN : 0 0 0 1 0 0 0 1	
OUTPUT PATTERN LOOKUP	ROW NUMBER 0
	ROW NUMBER 1
	ROW NUMBER 2
	ROW NUMBER 3
	ROW NUMBER 4
	ROW NUMBER 5

FIG. 34F



0080250 - 0967359

FIG. 35

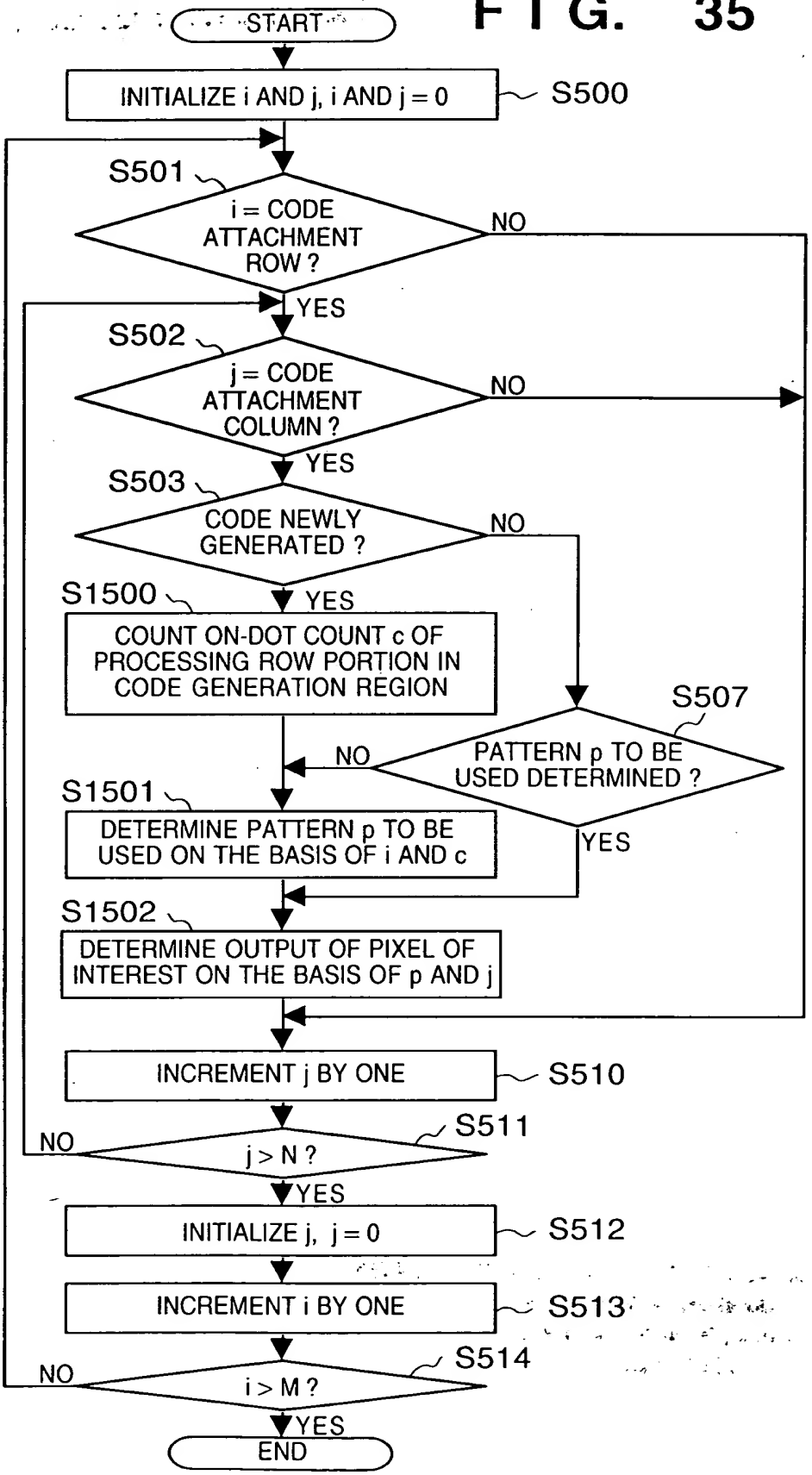


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FIG. 36

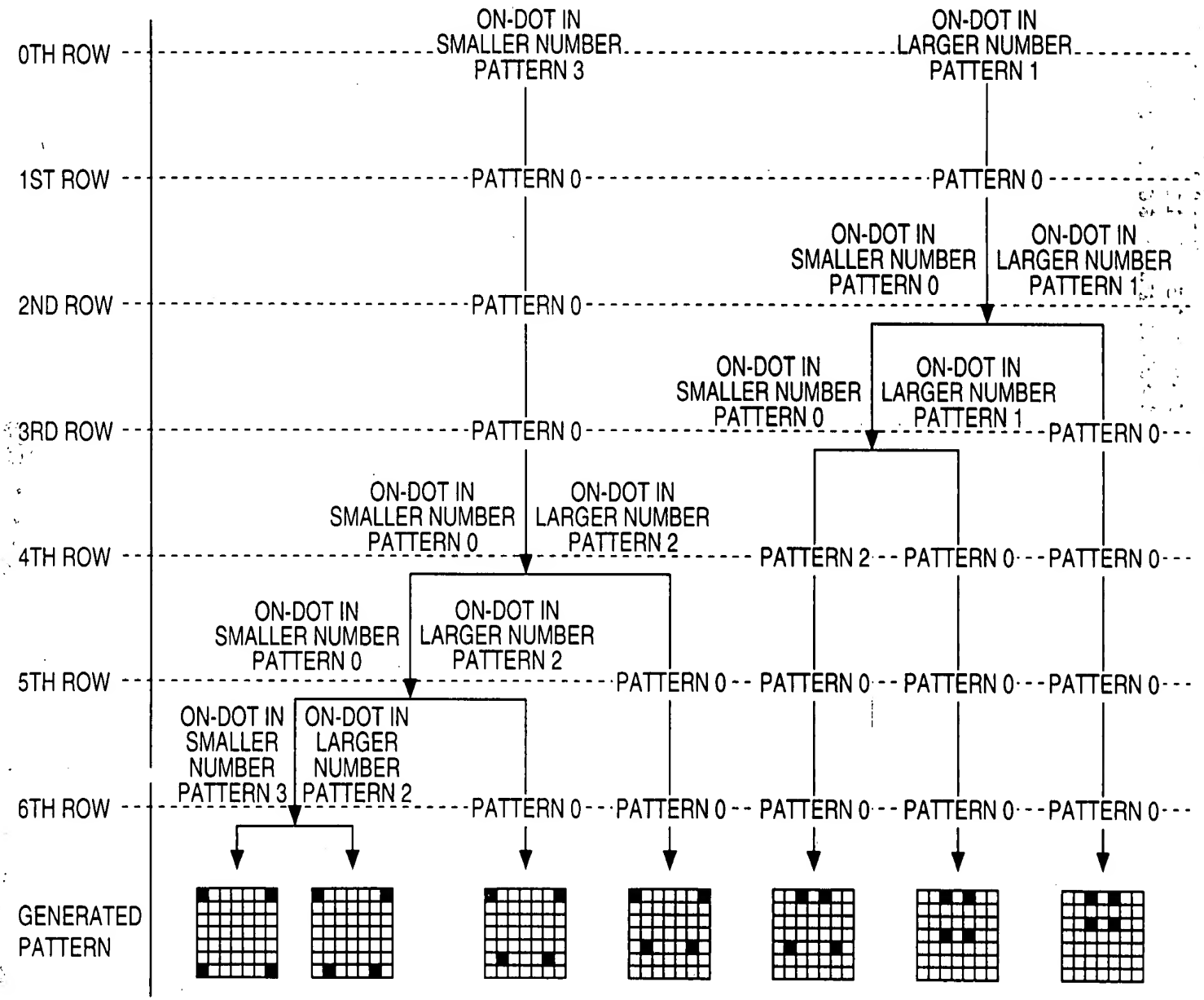
0TH ROW
1ST ROW
2ND ROW
3RD ROW
4TH ROW
5TH ROW
6TH ROW
GENERATED PATTERN
ON-DOT IN SMALLER NUMBER PATTERN 3
ON-DOT IN LARGER NUMBER PATTERN 1
PATTERN 0
ON-DOT IN SMALLER NUMBER PATTERN 0
ON-DOT IN LARGER NUMBER PATTERN 1
ON-DOT IN SMALLER NUMBER PATTERN 0
ON-DOT IN LARGER NUMBER PATTERN 2
ON-DOT IN SMALLER NUMBER PATTERN 0
ON-DOT IN LARGER NUMBER PATTERN 2
ON-DOT IN SMALLER NUMBER PATTERN 3
ON-DOT IN LARGER NUMBER PATTERN 2
PATTERN 2

FIG. 37

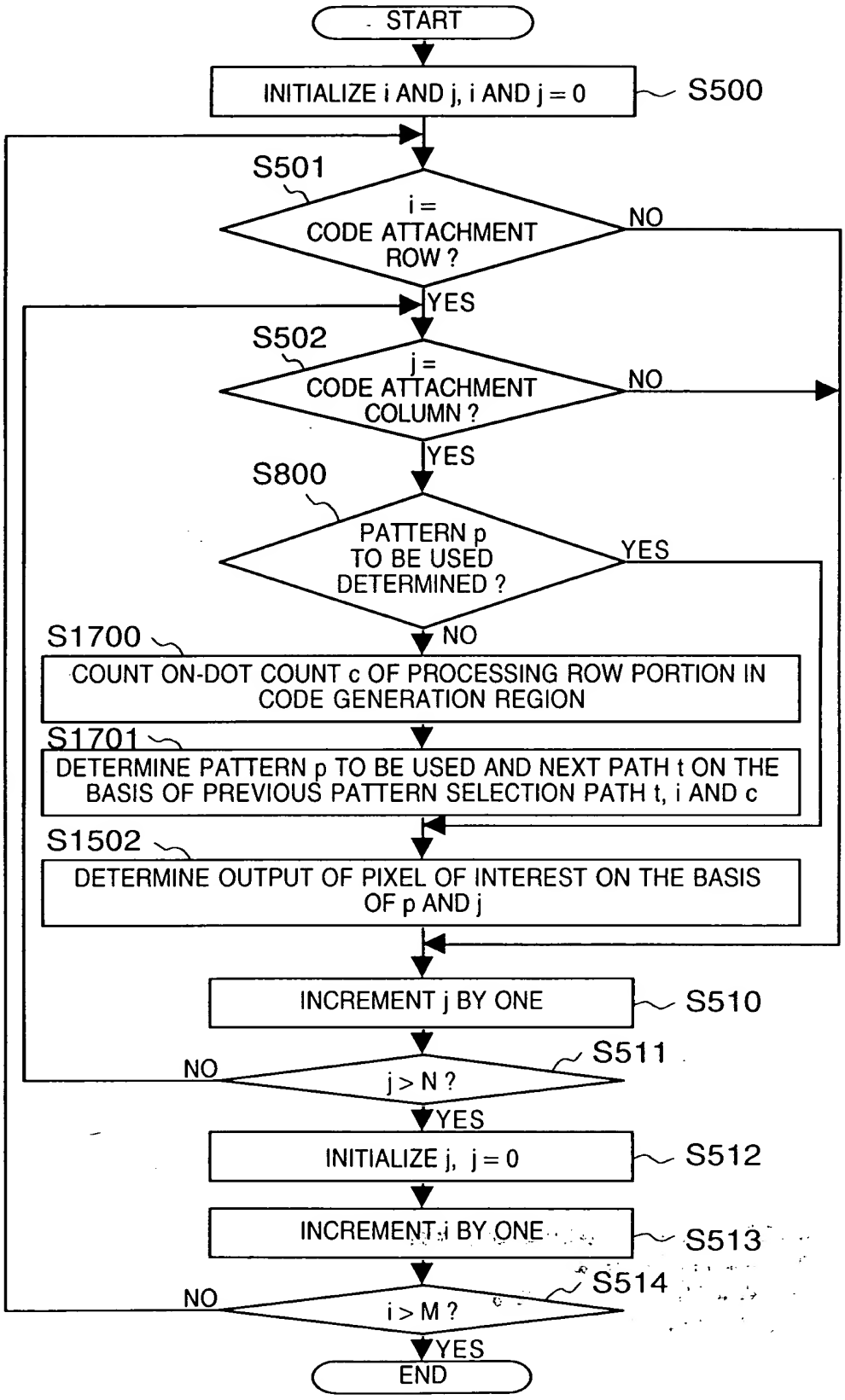
START
INITIALIZE i AND j, i AND j = 0
S500
S501
i = CODE ATTACHMENT ROW ?
NO
YES
S502
j = CODE ATTACHMENT COLUMN ?
NO
YES
S800
PATTERN p TO BE USED DETERMINED ?
YES
NO
S1700
COUNT ON-DOT COUNT c OF PROCESSING ROW PORTION IN CODE GENERATION REGION
S1701
DETERMINE PATTERN p TO BE USED AND NEXT PATH t ON THE BASIS OF PREVIOUS PATTERN SELECTION PATH t, i AND c
S1502
DETERMINE OUTPUT OF PIXEL OF INTEREST ON THE BASIS OF p AND j
INCREMENT j BY ONE
S510
S511
NO
j > N ?
YES
INITIALIZE j, j = 0
S512
INCREMENT i BY ONE
S513
S514
NO
i > M ?
YES
END

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FIG. 38

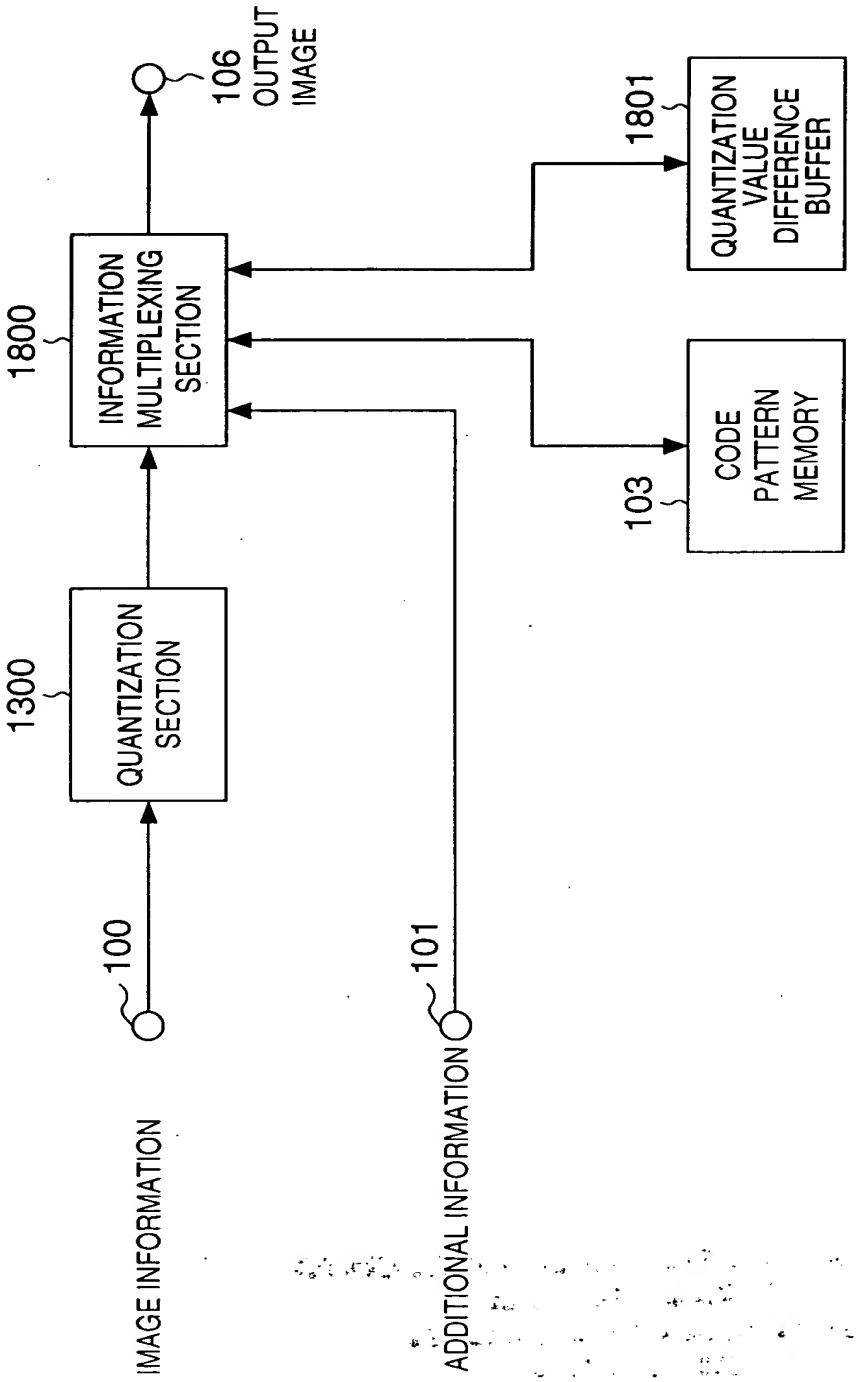

FIG. 39A

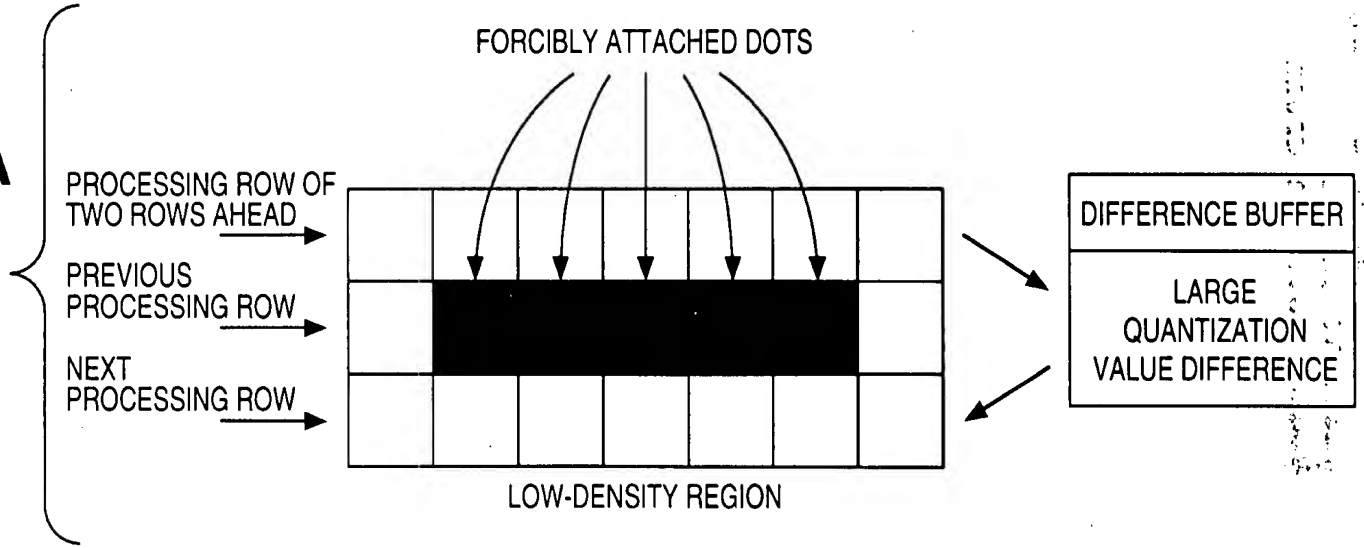

FIG. 39B

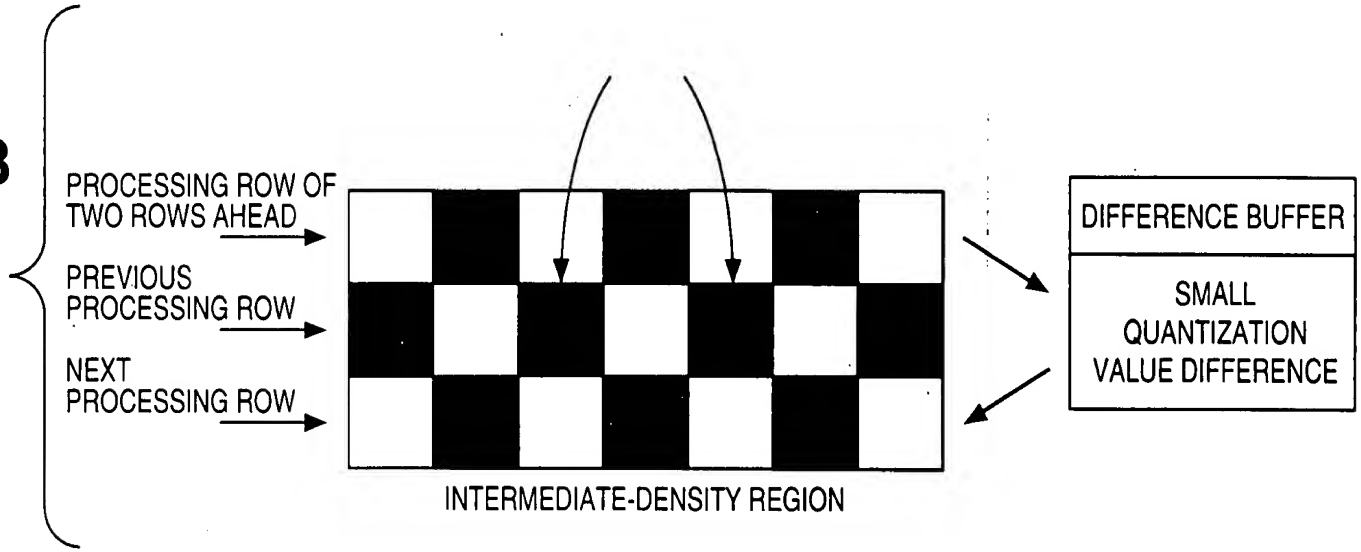

FIG. 40

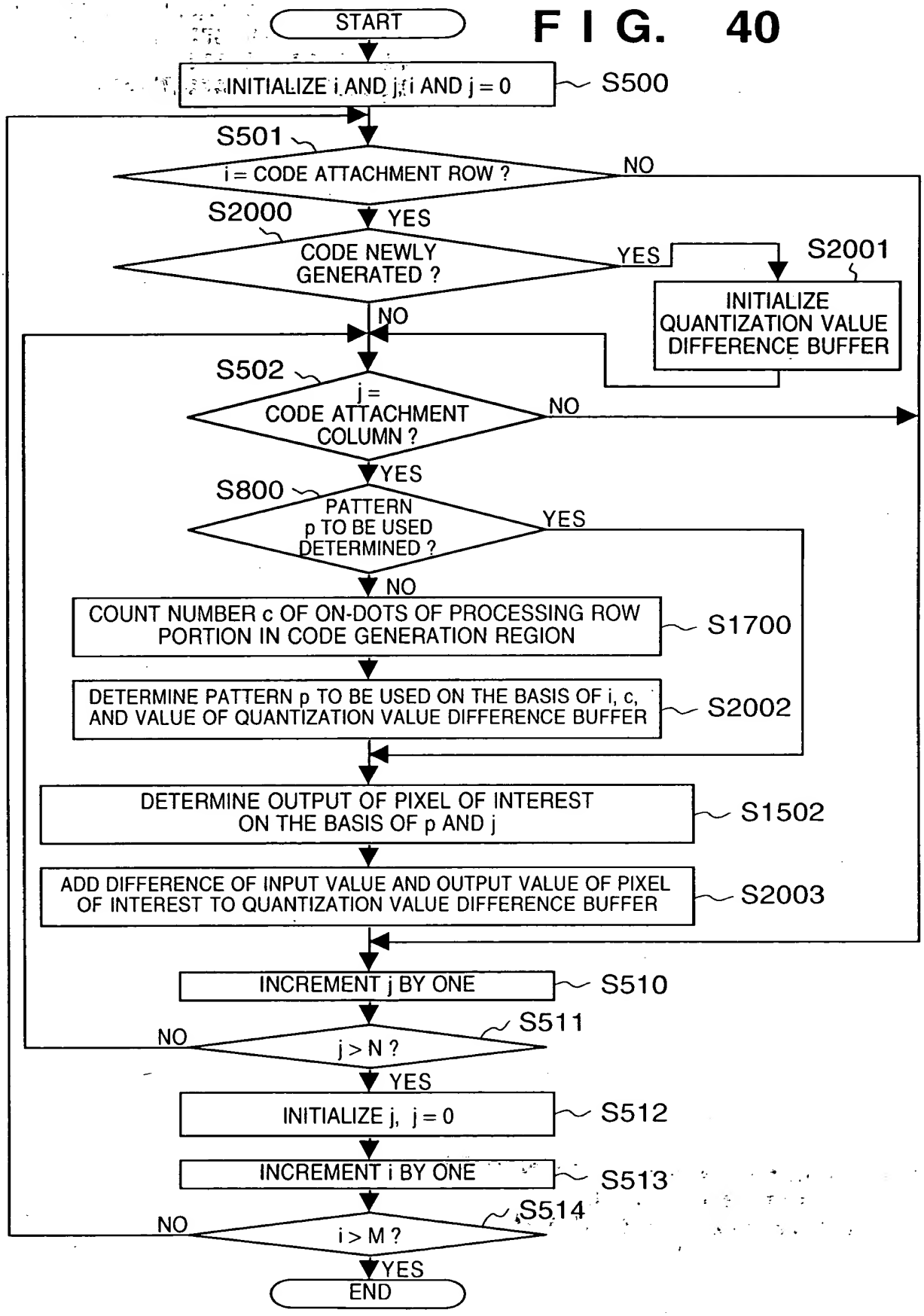

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FIG. 41

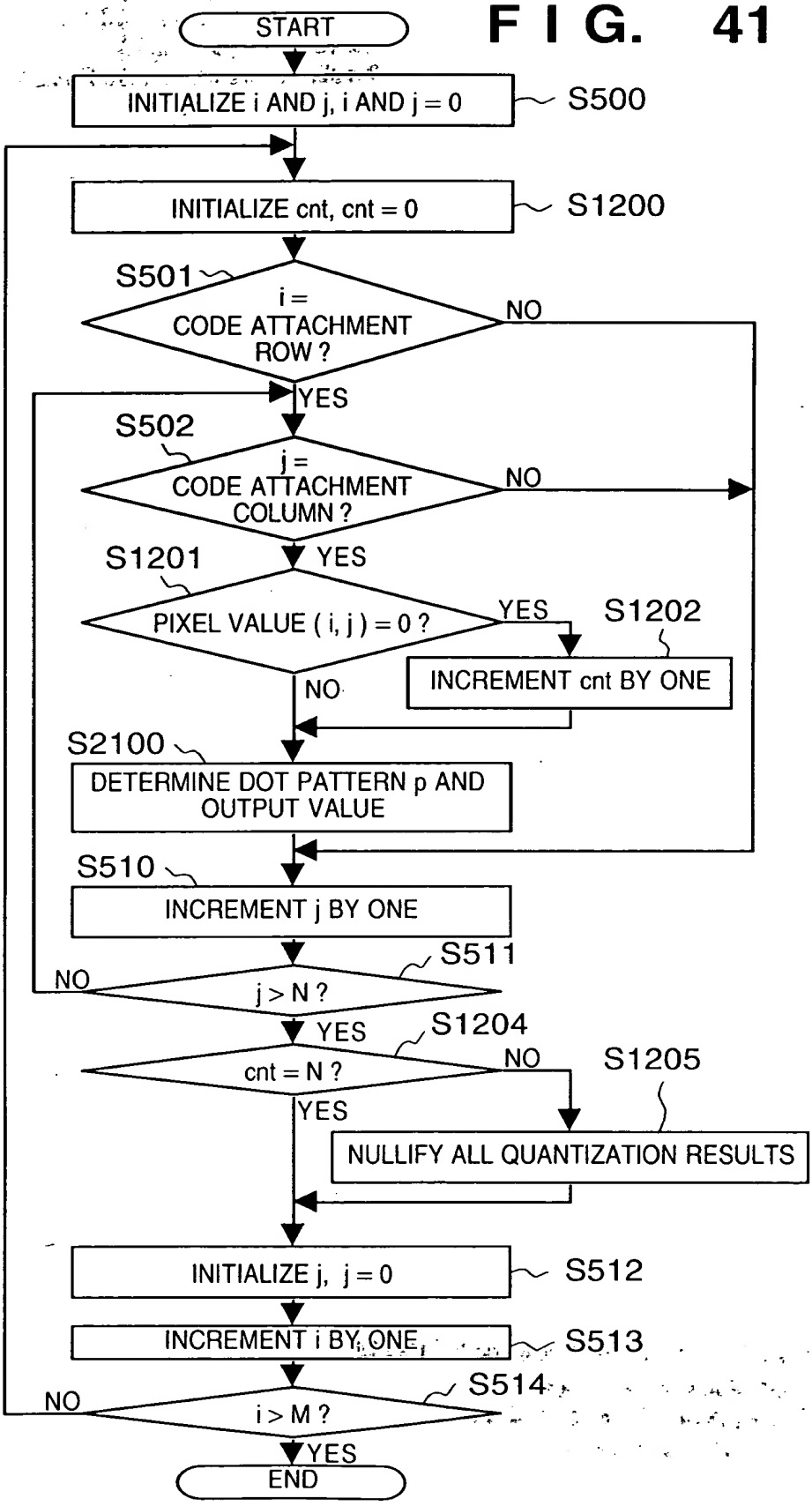

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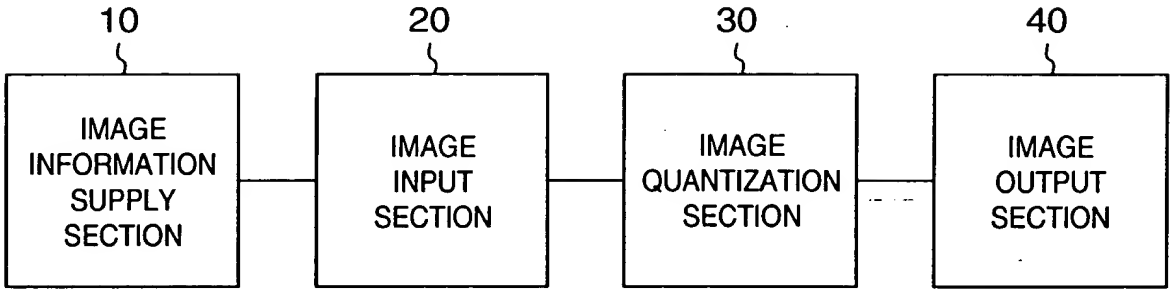
FIG. 42



09671623 "09280800

FIG. 43

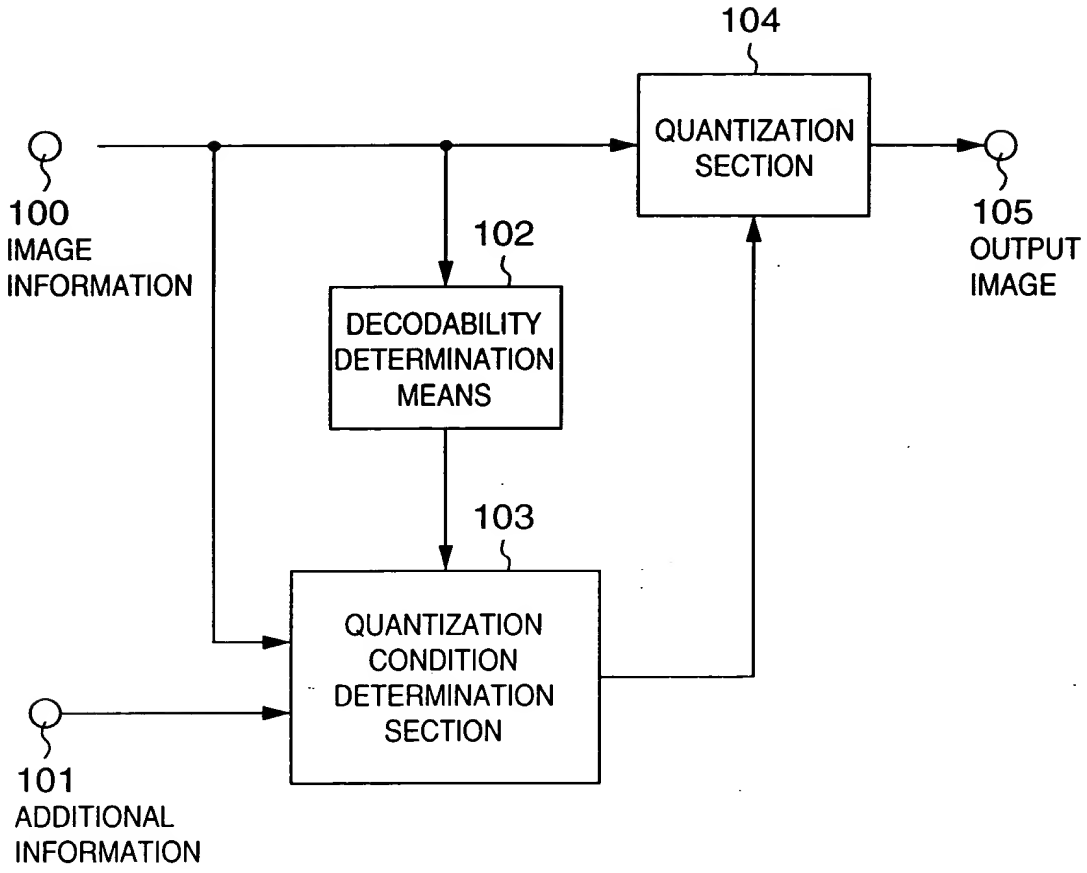


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FIG. 44

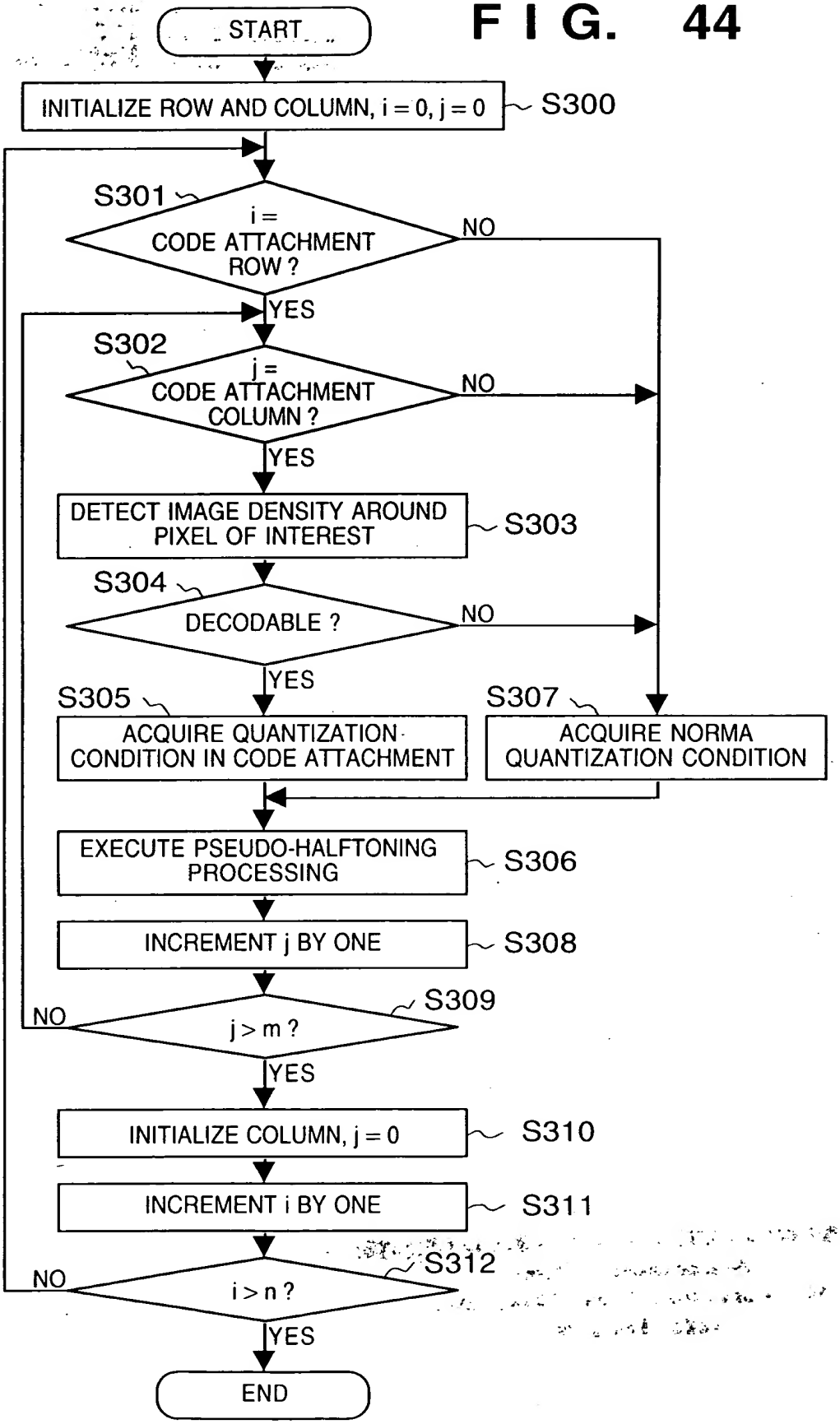
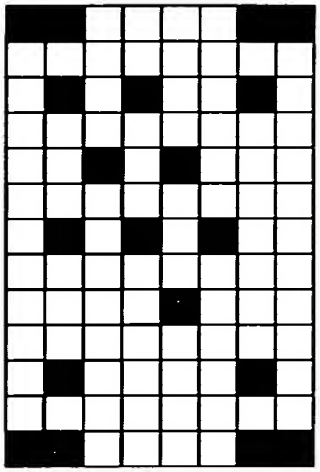

START
INITIALIZE ROW AND COLUMN, i = 0, j = 0
S300
S301
i = CODE ATTACHMENT ROW ?
NO
YES
S302
j = CODE ATTACHMENT COLUMN ?
NO
YES
DETECT IMAGE DENSITY AROUND PIXEL OF INTEREST
S303
S304
DECODABLE ?
NO
YES
S305
ACQUIRE QUANTIZATION CONDITION IN CODE ATTACHMENT
S307
ACQUIRE NORMA QUANTIZATION CONDITION
EXECUTE PSEUDO-HALFTONING PROCESSING
S306
INCREMENT j BY ONE
S308
S309
NO
j > m ?
YES
INITIALIZE COLUMN, j = 0
S310
INCREMENT i BY ONE
S311
S312
NO
i > n ?
YES
END

FIG. 45



■ : CODE

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0082650 "E291/960

FIG. 46

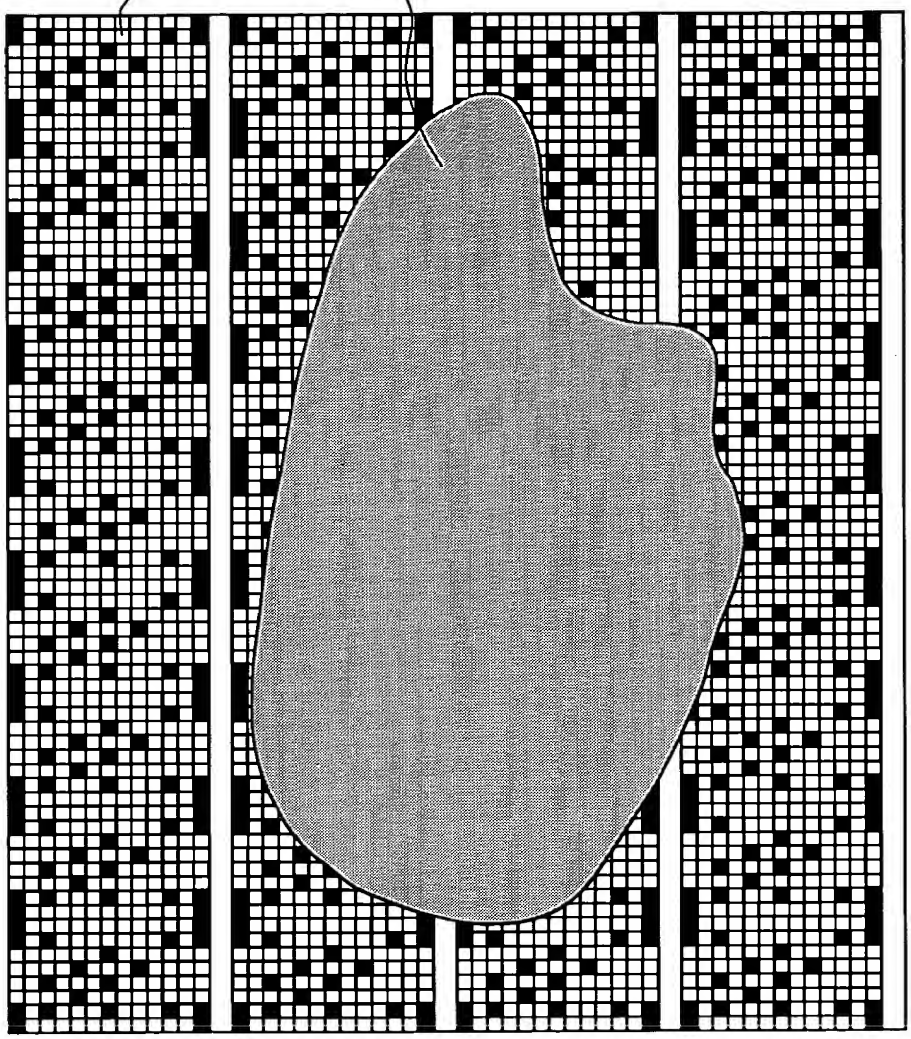
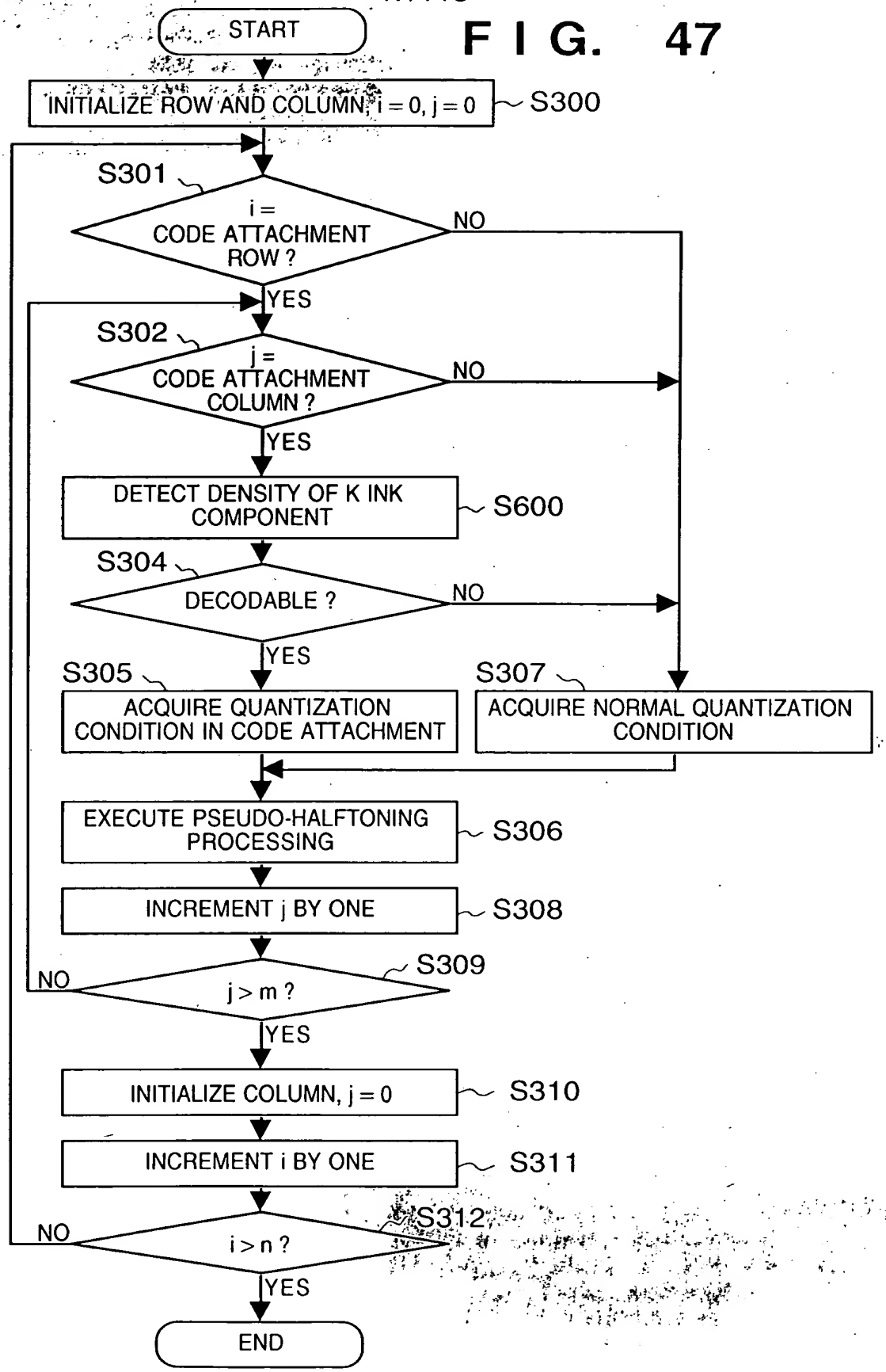
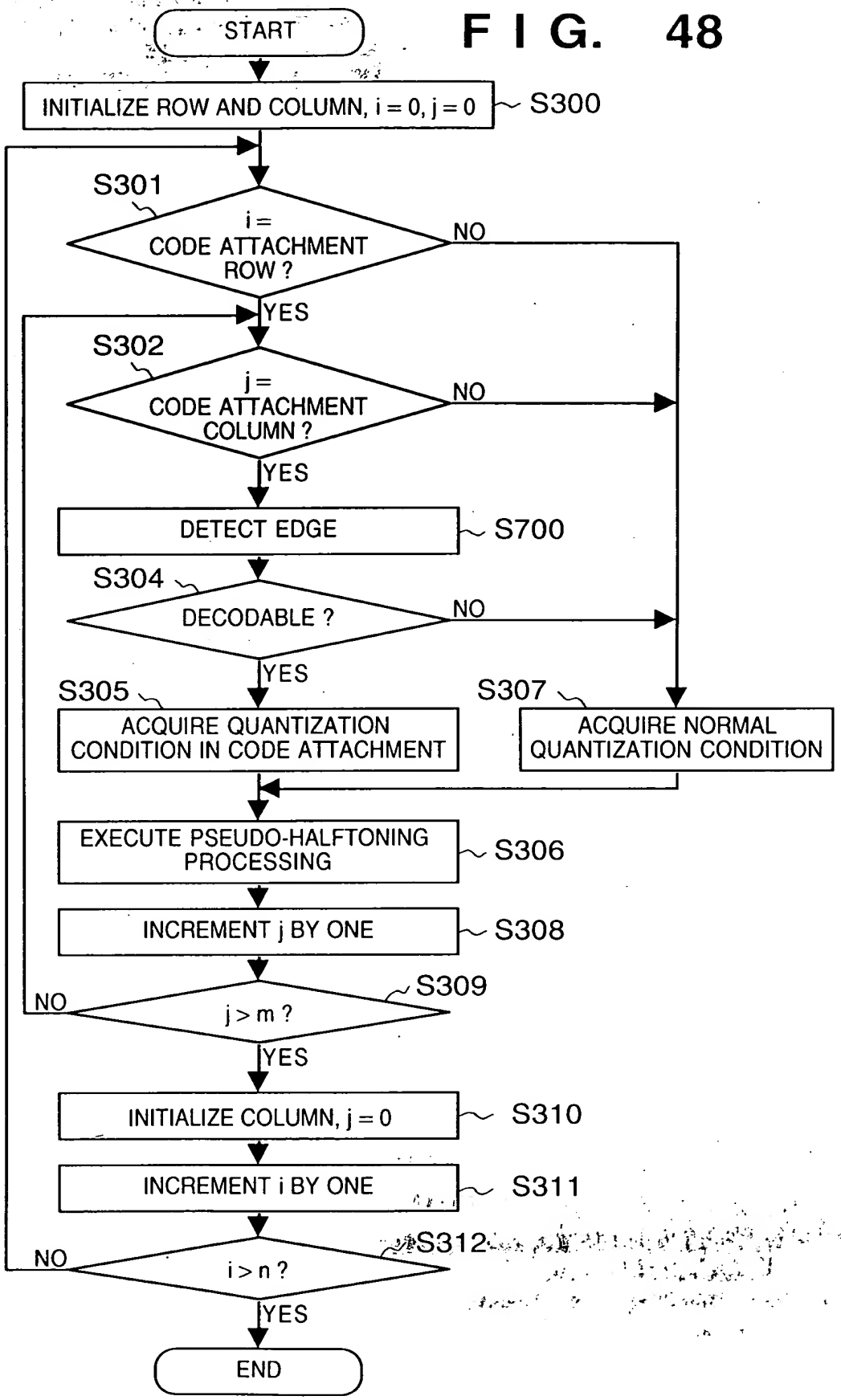


FIG. 47



09671623 '090800

FIG. 48



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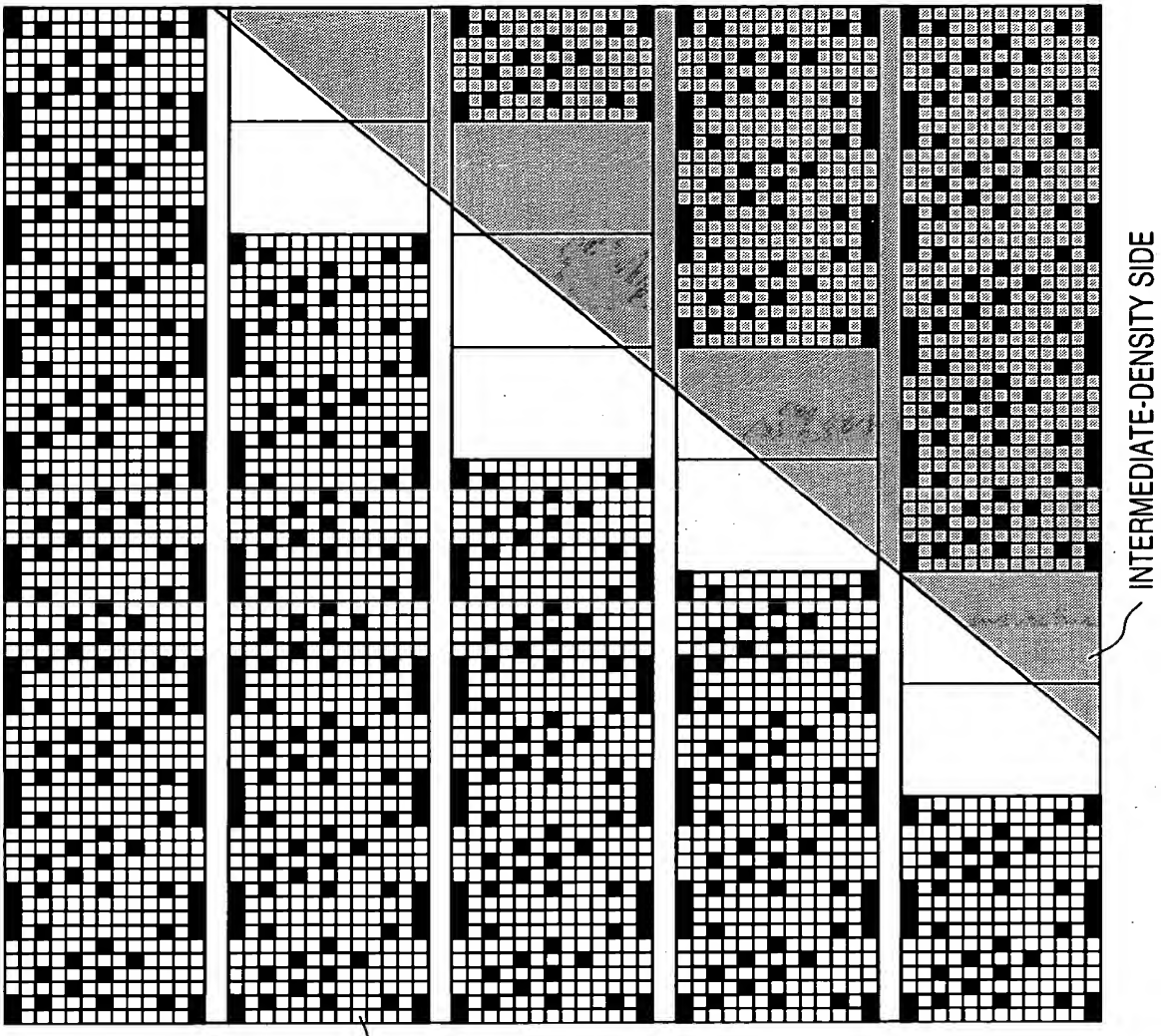
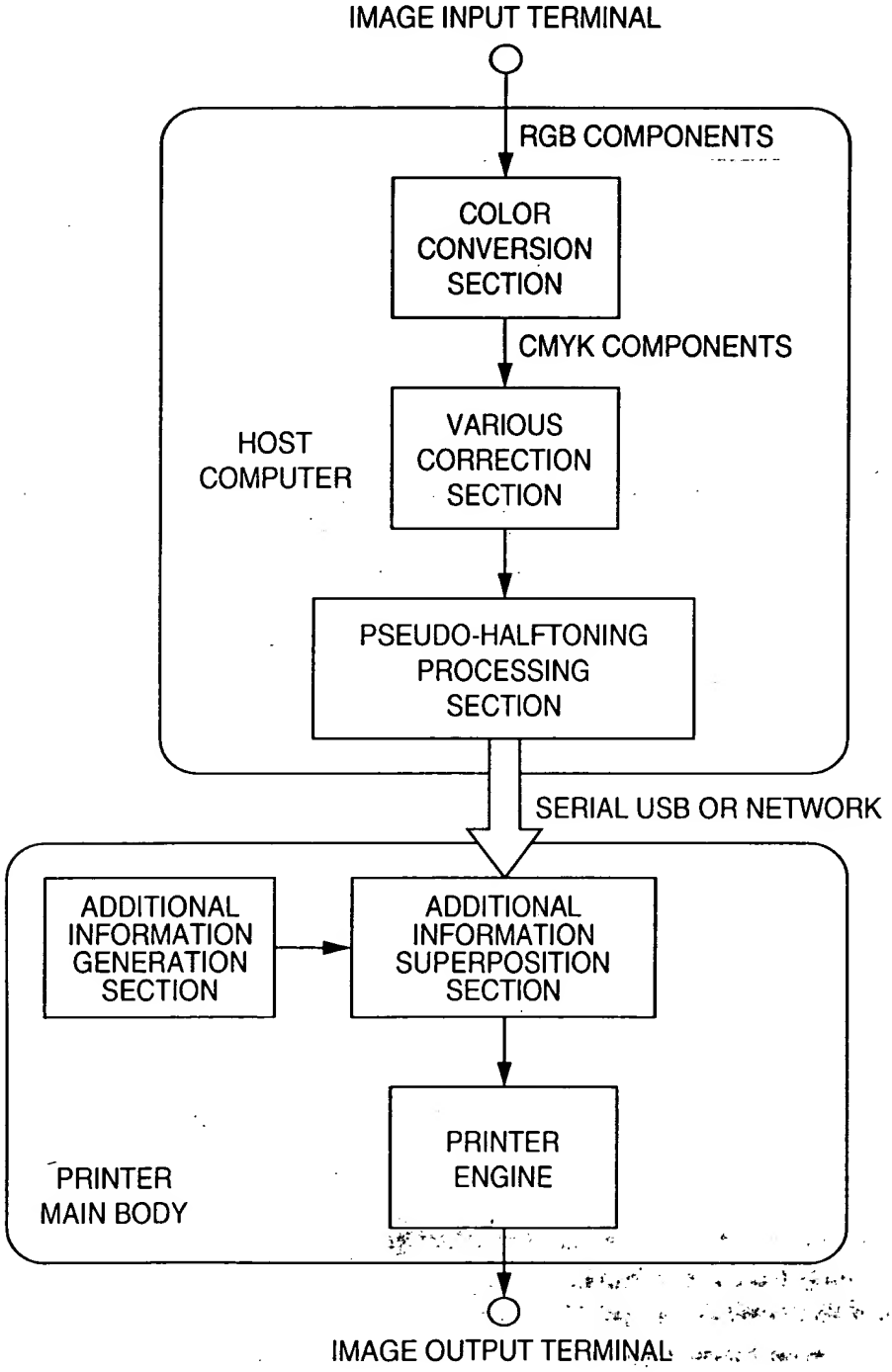


FIG. 49

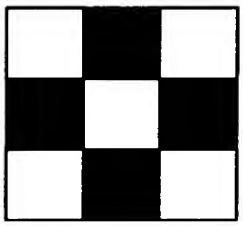
FIG. 50

ADDITIONAL INFORMATION SUPERPOSITION METHOD OF THE PRESENT INVENTION



0082609 "E29F7960

FIG. 51



0082609 "EP1659800

FIG. 52

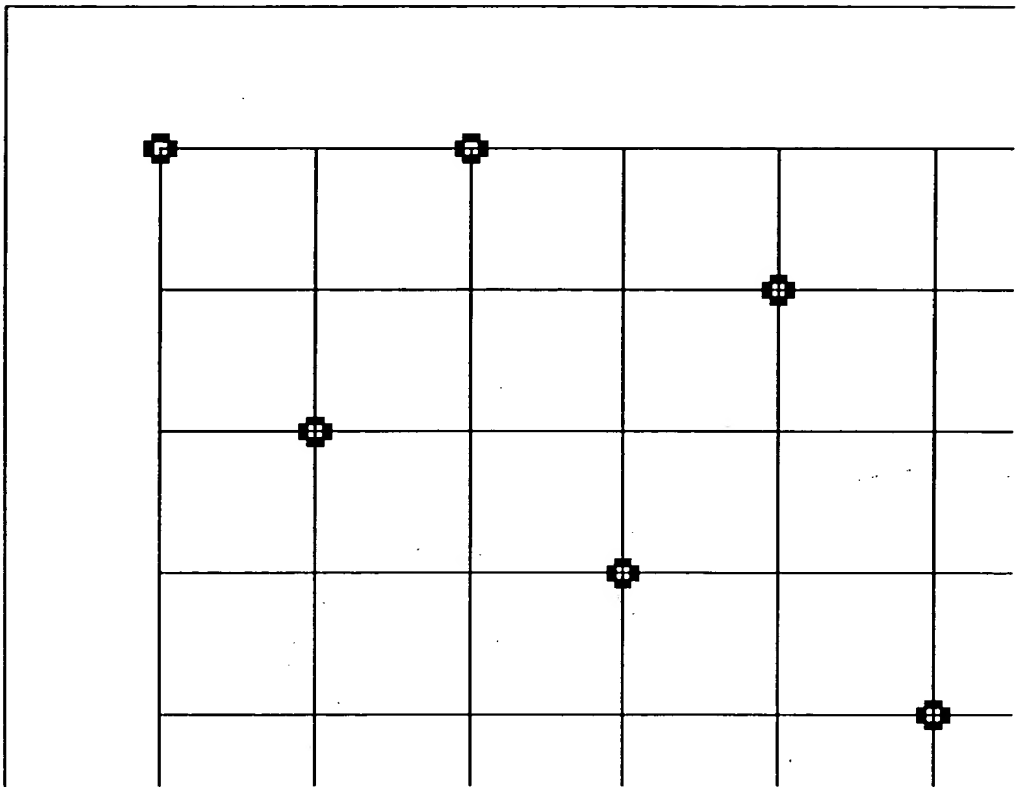


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FIG. 53

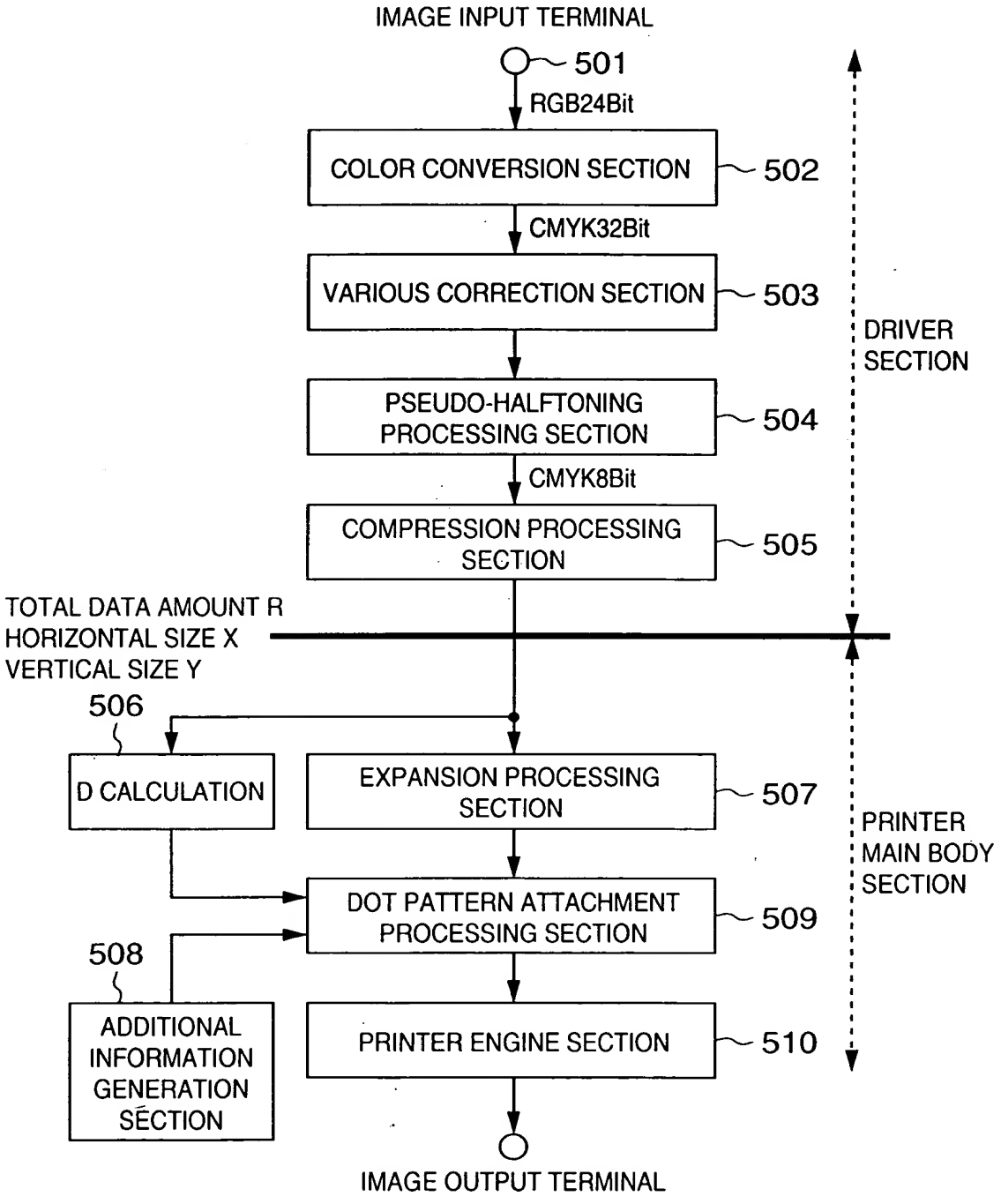


IMAGE INPUT TERMINAL
501
RGB24Bit
COLOR CONVERSION SECTION
502
CMYK32Bit
VARIOUS CORRECTION SECTION
503
PSEUDO-HALFTONING PROCESSING SECTION
504
CMYK8Bit
COMPRESSION PROCESSING SECTION
505
DRIVER SECTION
TOTAL DATA AMOUNT R
HORIZONTAL SIZE X
VERTICAL SIZE Y
506
D CALCULATION
EXPANSION PROCESSING SECTION
507
PRINTER MAIN BODY SECTION
DOT PATTERN ATTACHMENT PROCESSING SECTION
509
508
ADDITIONAL INFORMATION GENERATION SECTION
PRINTER ENGINE SECTION
510
IMAGE OUTPUT TERMINAL

0082601 "EP0917960

FIG. 54

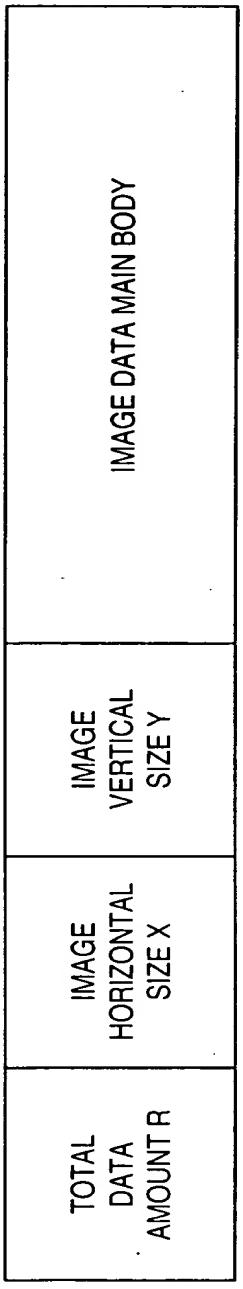


FIG. 55A

SIMPLE IMAGE

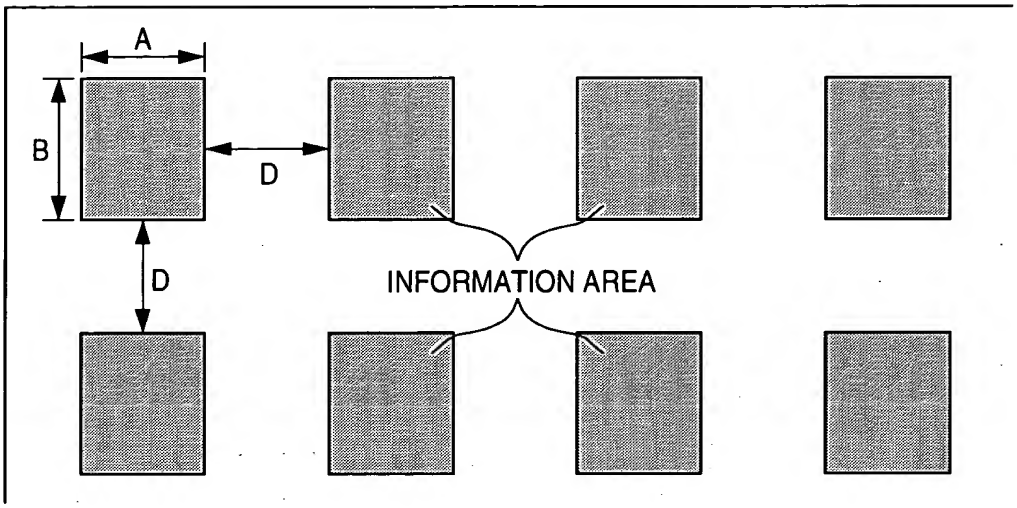
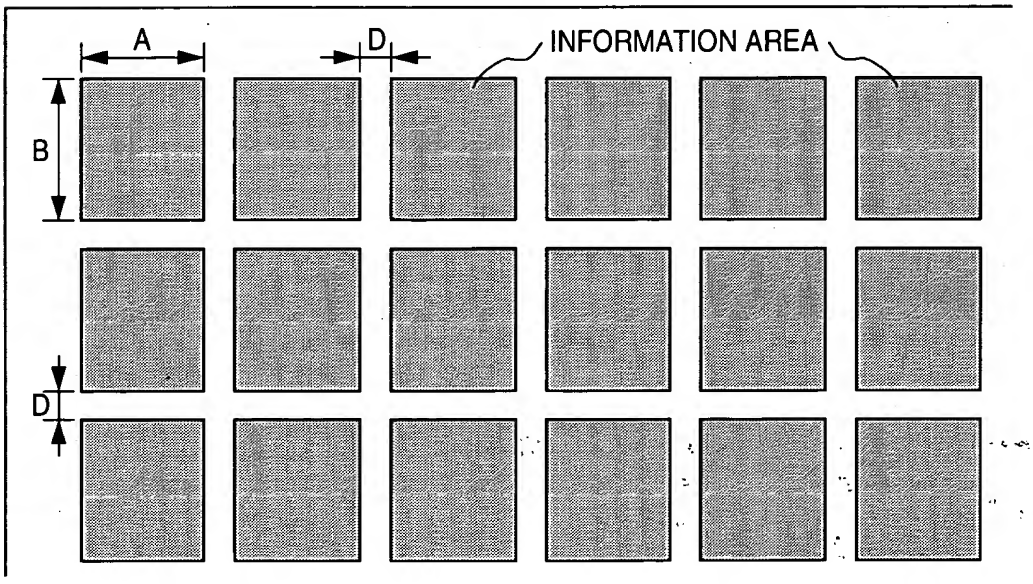


FIG. 55B

COMPLEX IMAGE



0096716230.0928000

FIG. 56

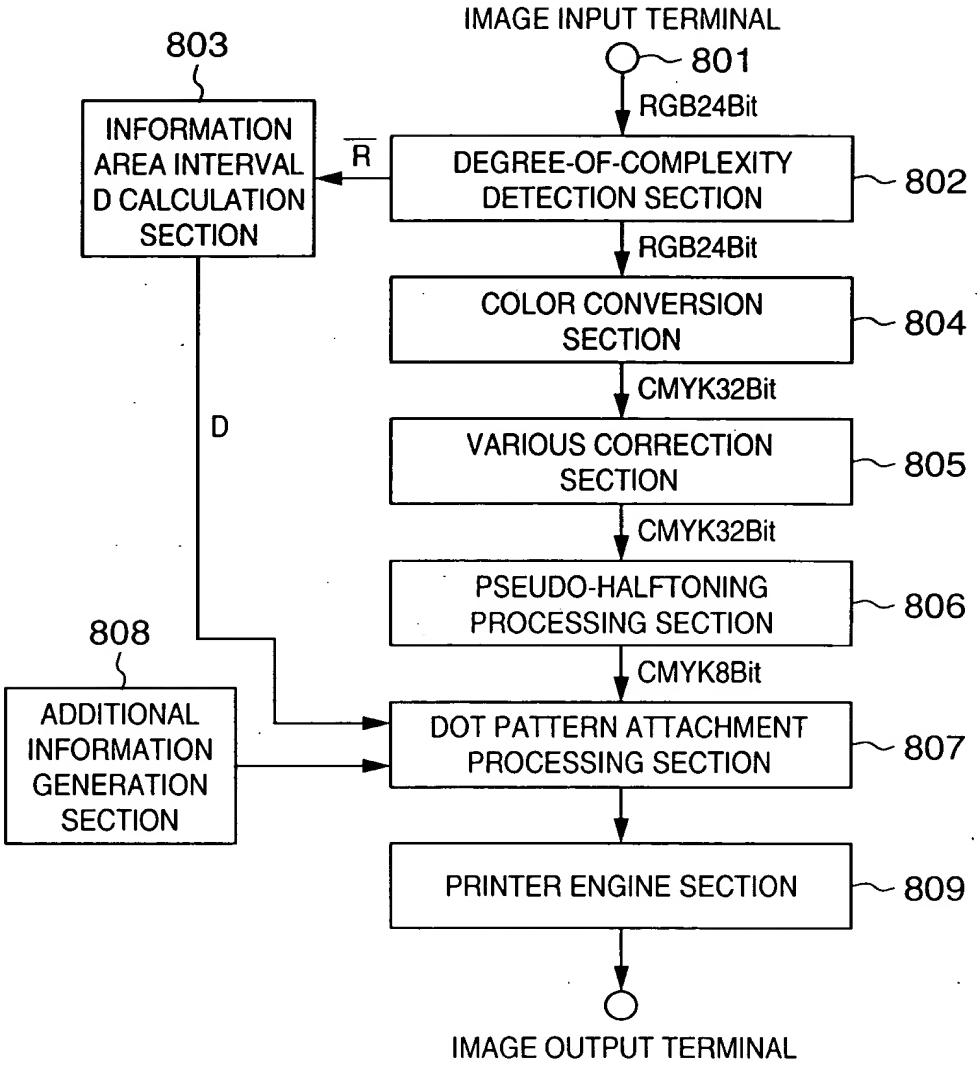


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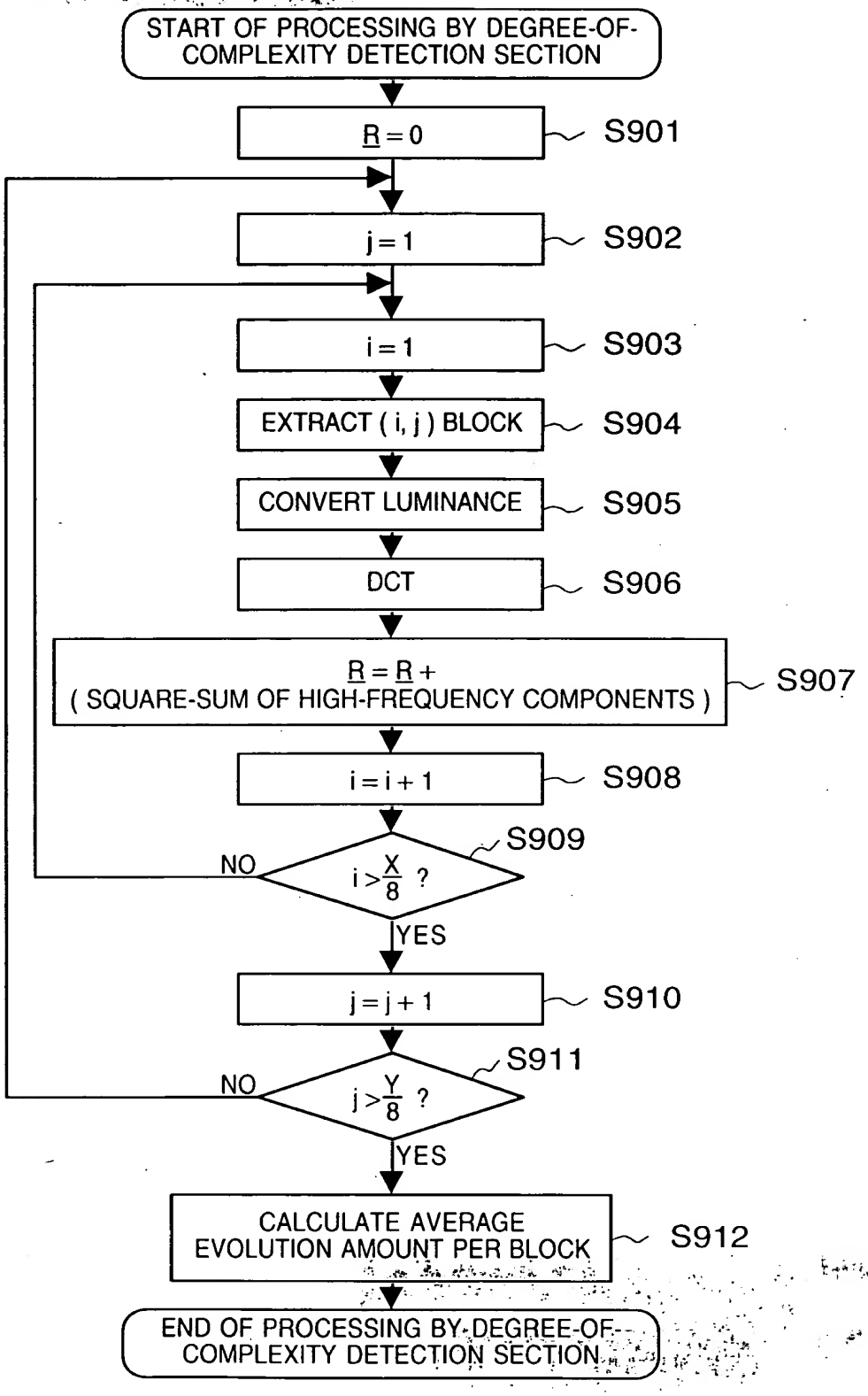
FIG. 57



0096723.0960800

FIG. 58

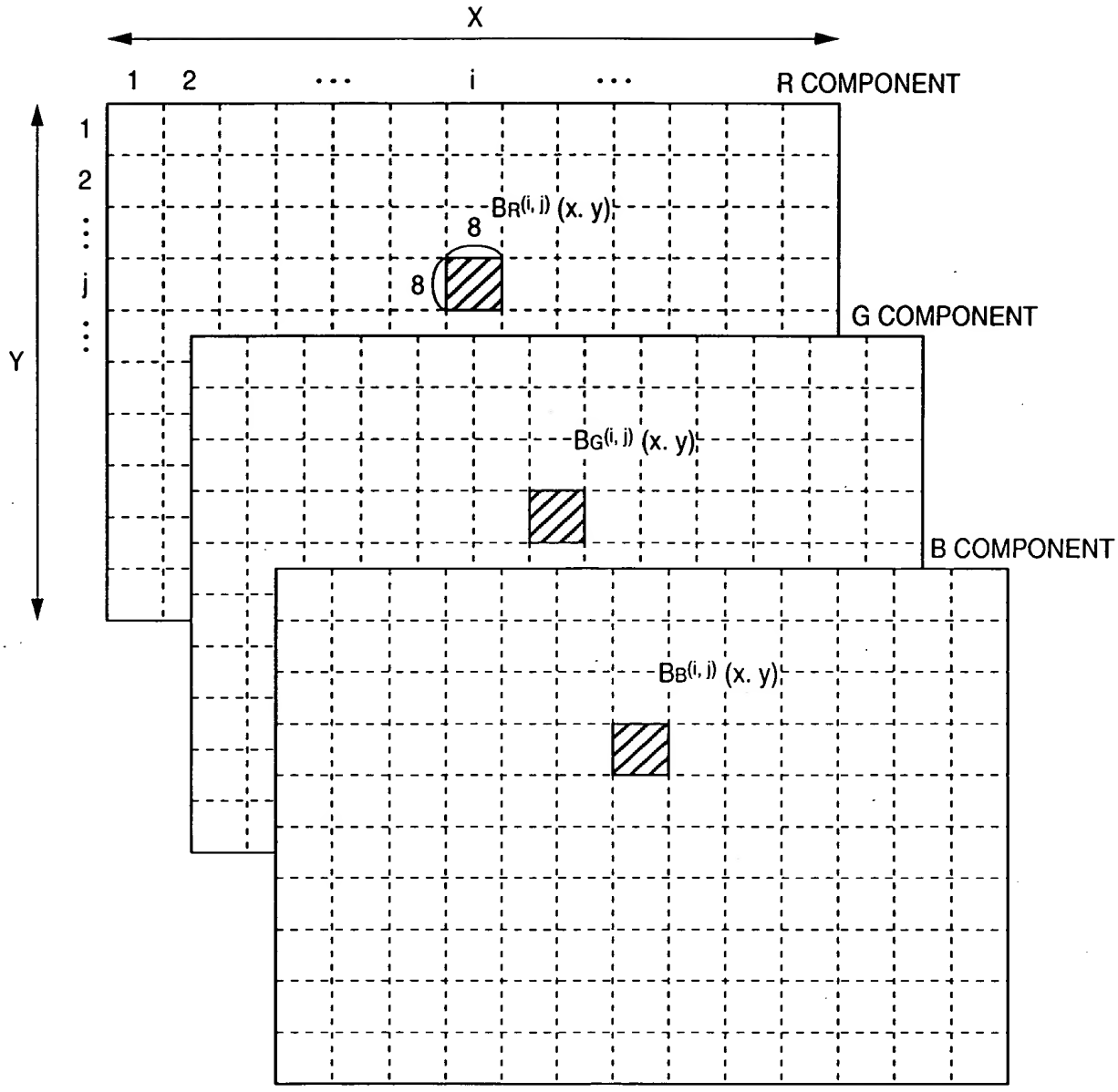


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FIG. 59

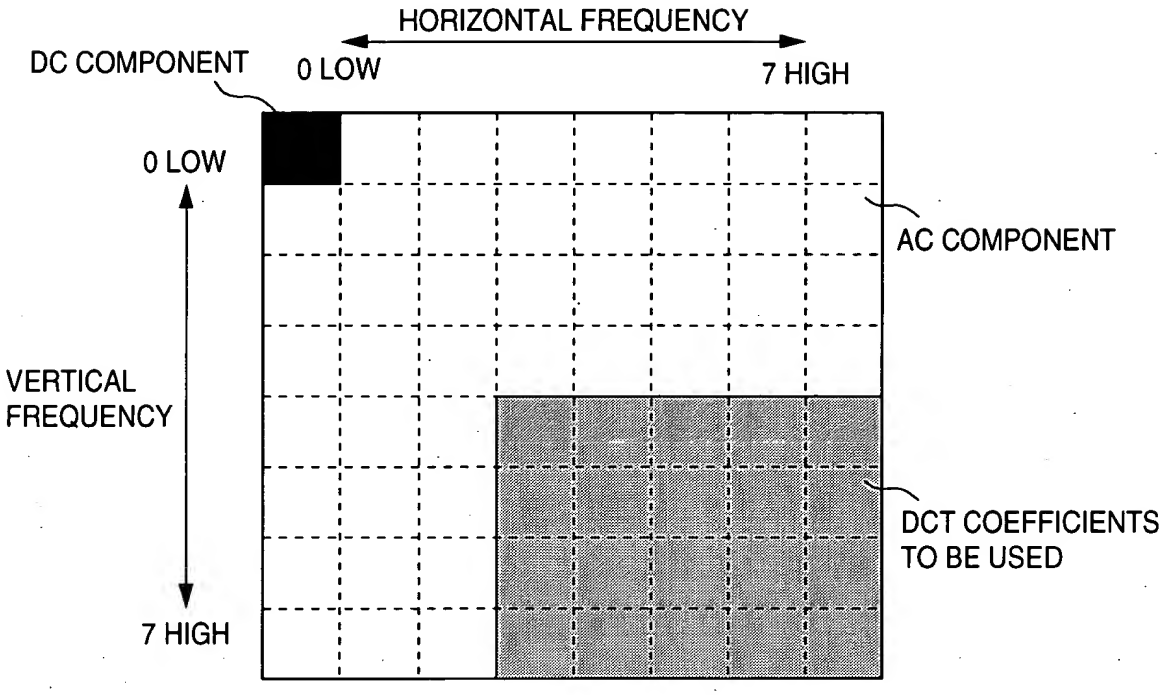

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FIG. 60

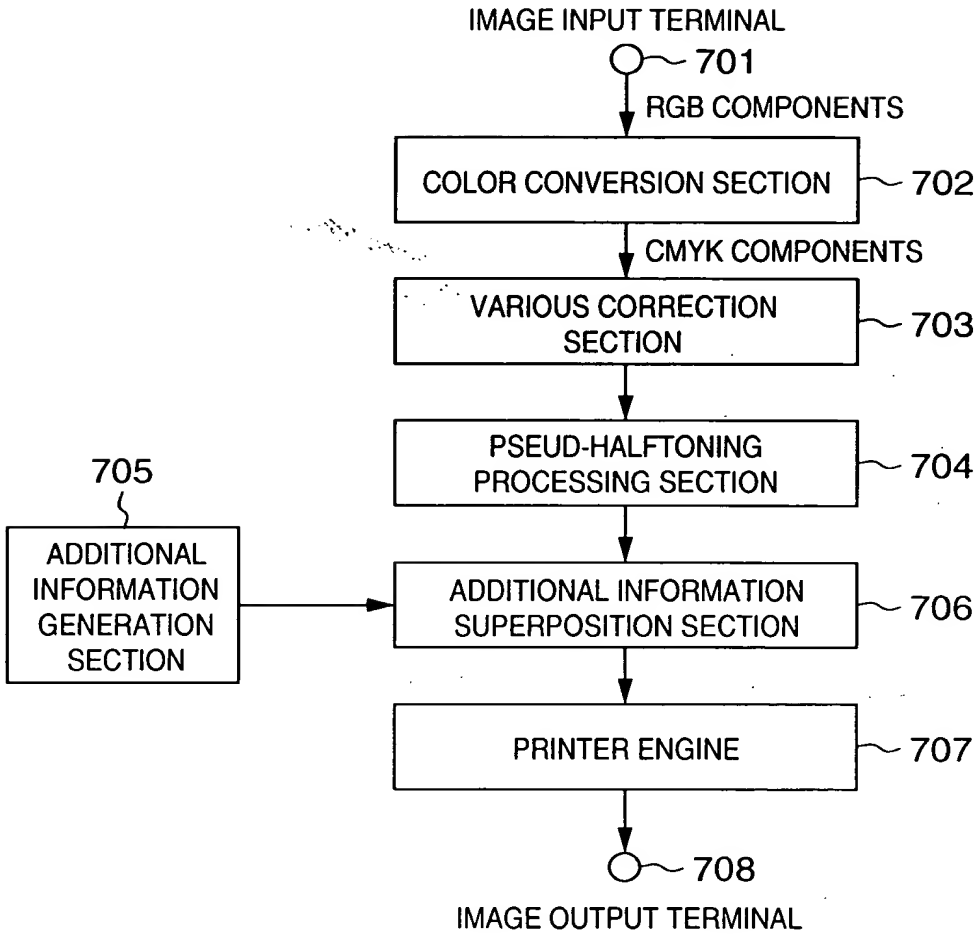

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FIG. 61

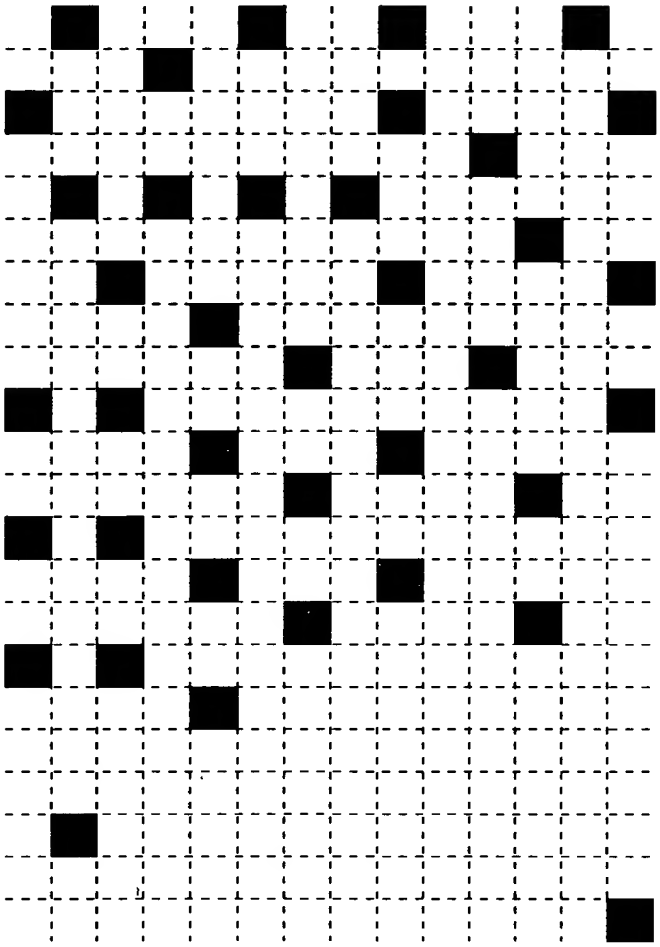

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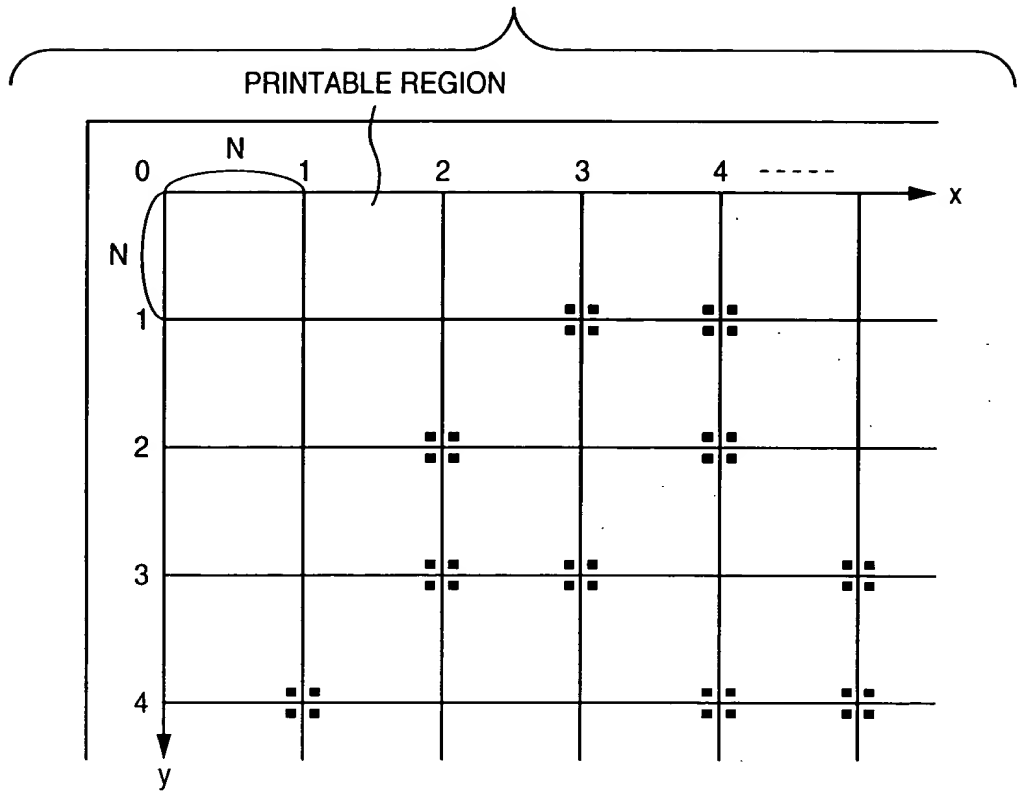
FIG. 62



MATRIX INTERVAL	N
NUMBER z	ATTACHMENT POSITION (Lx^z, Ly^z)
1	(1, 1)
2	(1, 3)
3	(1, 4)
⋮	⋮
z	(Lx^z, Ly^z)

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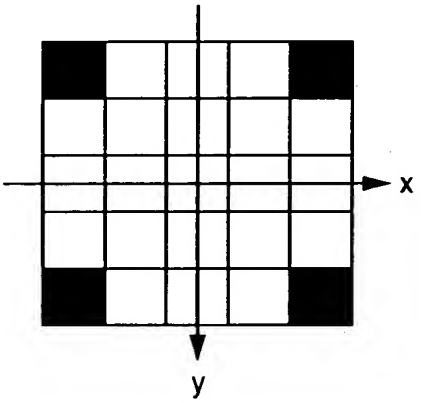
FIG. 63A

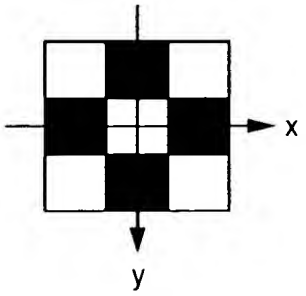
DOT PATTERN FOR LOW-DENSITY REGION



PIXEL COUNT C OF PATTERN	4
NUMBER c	PIXEL POSITION (Plx^c, Ply^c)
1	(2, –2)
2	(–2, –2)
3	(2, 2)
4	(–2, 2)

FIG. 63B

DOT PATTERN FOR HIGH-DENSITY REGION



PIXEL COUNT C OF PATTERN	4
NUMBER c	PIXEL POSITION (Phx^c, Phy^c)
1	(1, 0)
2	(0, –1)
3	(–1, 0)
4	(0, 1)

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FIG. 64

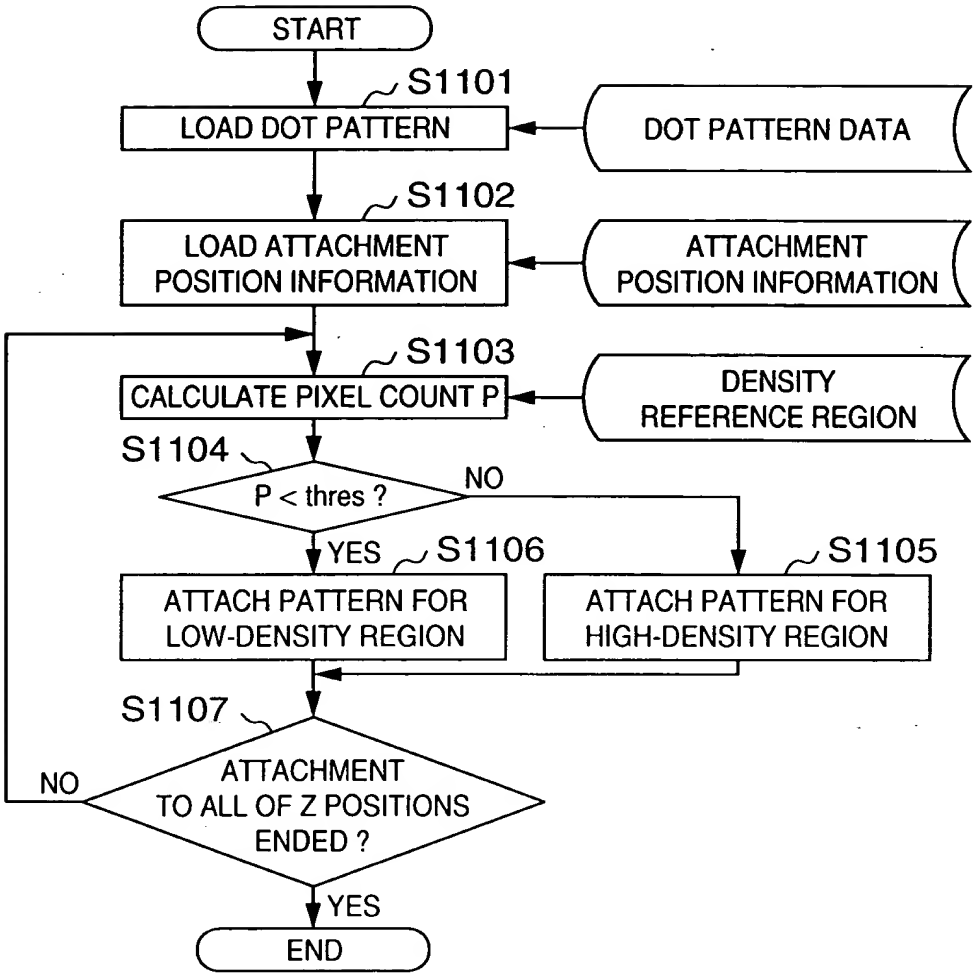
START
S1101
LOAD DOT PATTERN
DOT PATTERN DATA
S1102
LOAD ATTACHMENT POSITION INFORMATION
ATTACHMENT POSITION INFORMATION
S1103
CALCULATE PIXEL COUNT P
DENSITY REFERENCE REGION
S1104
P < thres ?
NO
YES
S1106
ATTACH PATTERN FOR LOW-DENSITY REGION
S1105
ATTACH PATTERN FOR HIGH-DENSITY REGION
S1107
NO
ATTACHMENT TO ALL OF Z POSITIONS ENDED ?
YES
END

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FIG. 65

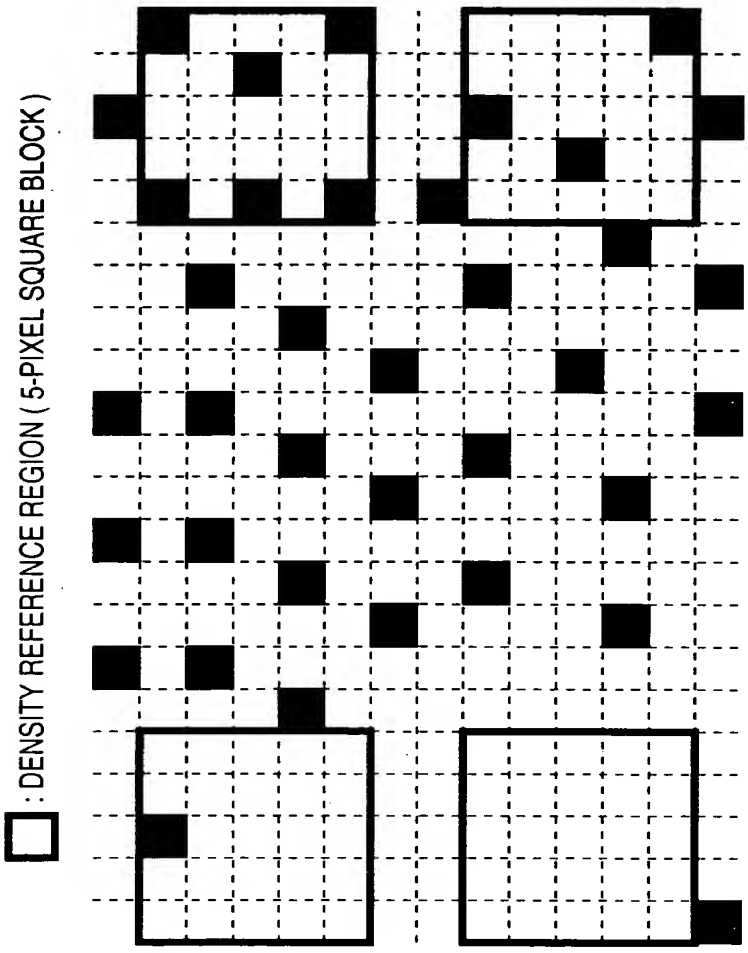
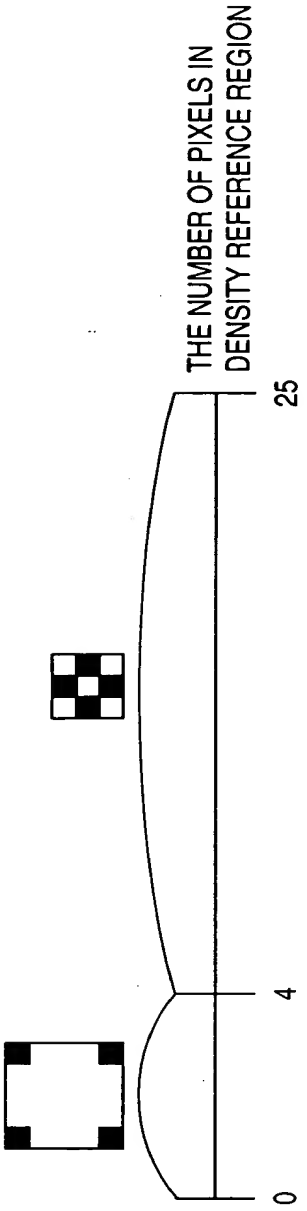


FIG. 66



0082640 E29T/960

FIG. 67A

IMAGE BEFORE DOT PATTERN ATTACHMENT

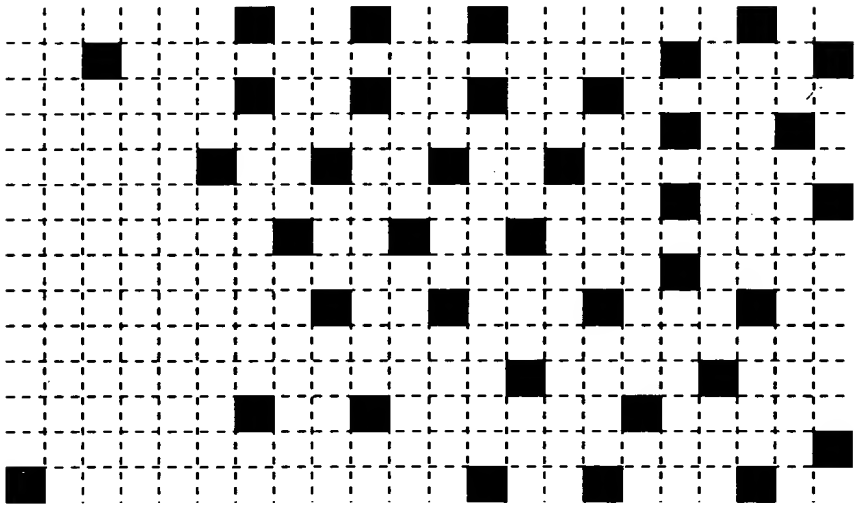
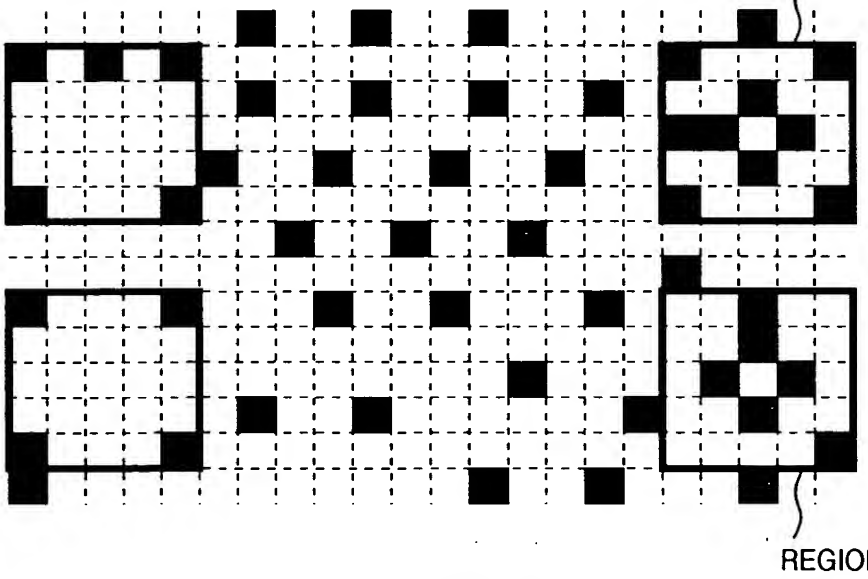


FIG. 67B

IMAGE AFTER DOT PATTERN ATTACHMENT



: DOT PATTERN ATTACHMENT REGION

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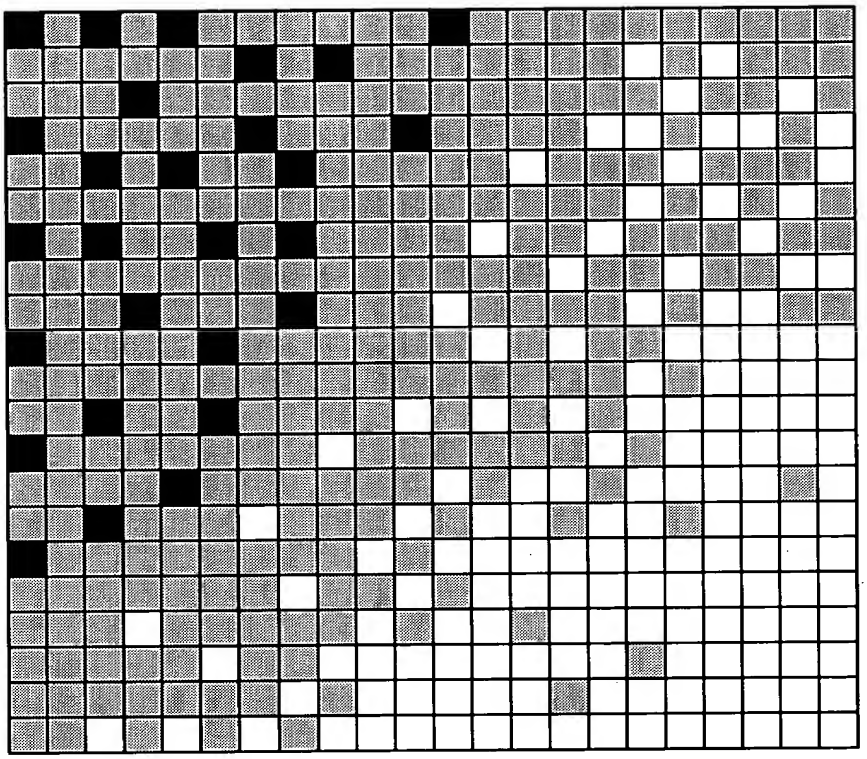
FIG. 68



■ : DENSITY LEVEL 2

▒ : DENSITY LEVEL 1

□ : DENSITY LEVEL 0

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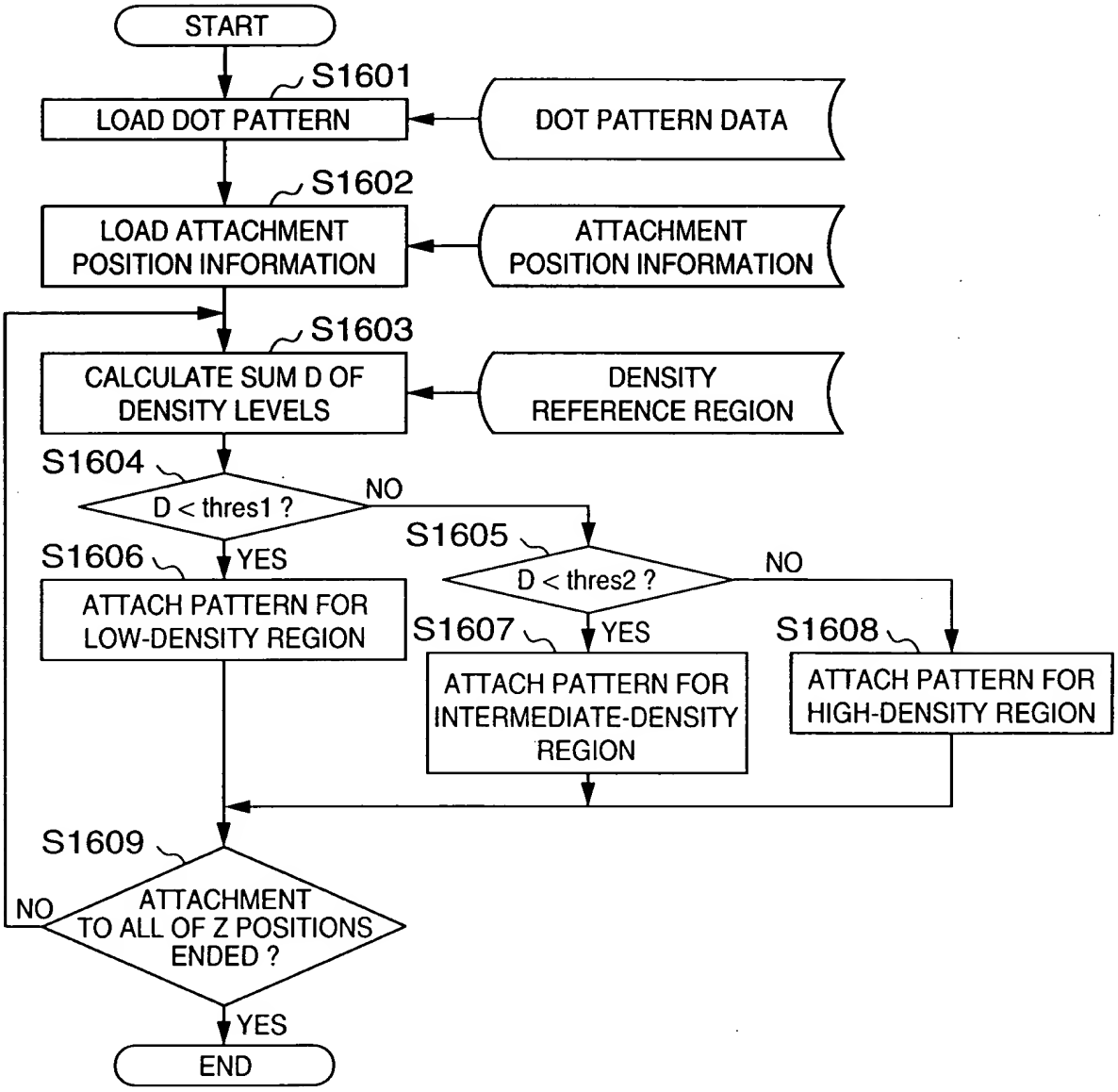
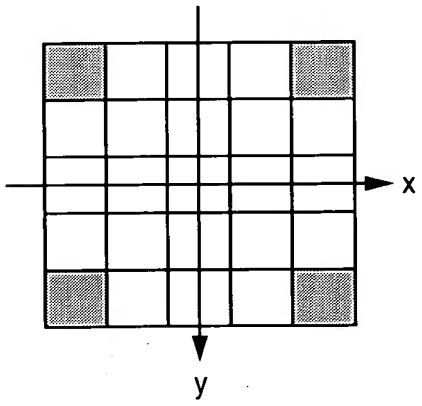
FIG. 69



0082860 E2917960

FIG. 70A

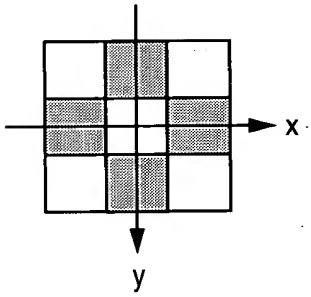
DOT PATTERN FOR LOW-DENSITY REGION



PIXEL COUNT C OF PATTERN	4
DENSITY LEVEL V	−1
NUMBER c	PIXEL POSITION (P_{lx}^{c}, P_{ly}^{c})
1	(2, −2)
2	(−2, −2)
3	(−2, 2)
4	(2, 2)

FIG. 70B

DOT PATTERN FOR INTERMEDIATE-DENSITY REGION



PIXEL COUNT C OF PATTERN	4
DENSITY LEVEL V	1
NUMBER c	PIXEL POSITION (P_{mx}^{c}, P_{my}^{c})
1	(1, 0)
2	(0, −1)
3	(−1, 0)
4	(0, 1)

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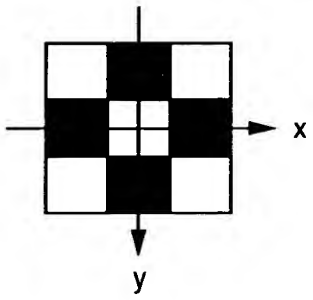
FIG. 71

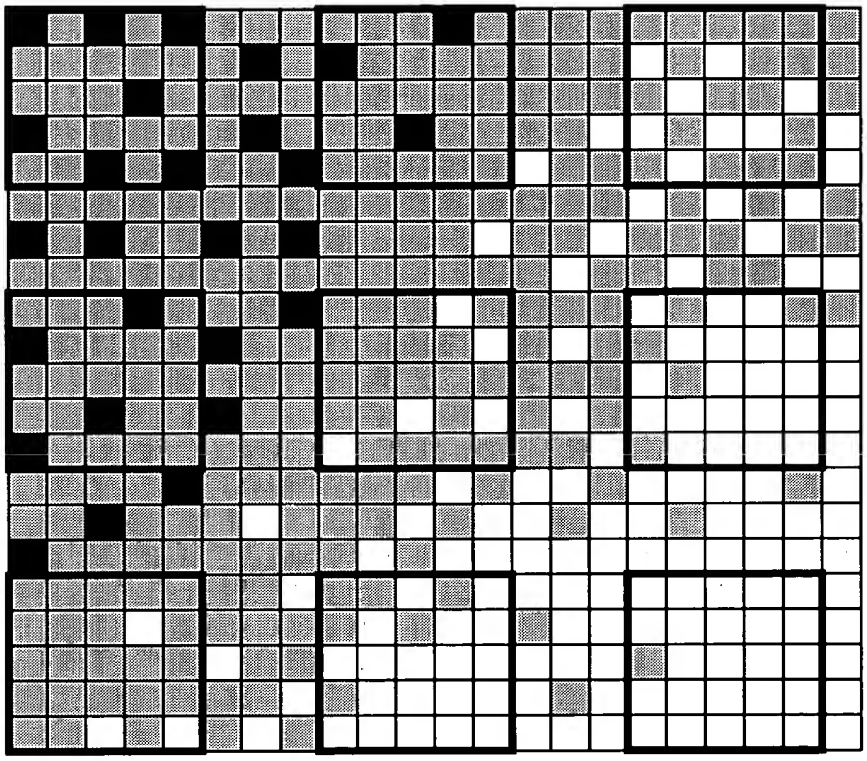
DOT PATTERN FOR HIGH-DENSITY REGION



PIXEL COUNT C OF PATTERN	4
DENSITY LEVEL V	2
NUMBER c	PIXEL POSITION (Phx^c, Phy^c)
1	(1, 0)
2	(0, −1)
3	(−1, 0)
4	(0, 1)

0096715230.090800

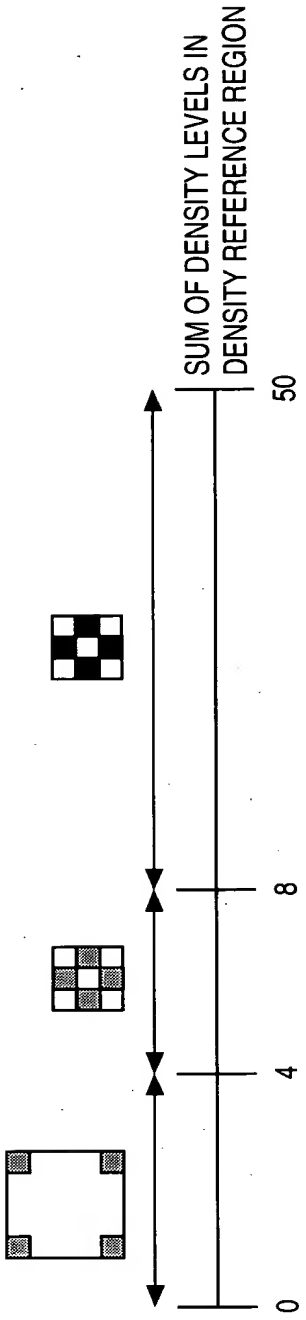
FIG. 72



: DENSITY REFERENCE REGION
(5-PIXEL SQUARE BLOCK)

0082603 EP 0796800

FIG. 73



0082603 E3971960

FIG. 74A

IMAGE BEFORE DOT PATTERN ATTACHMENT

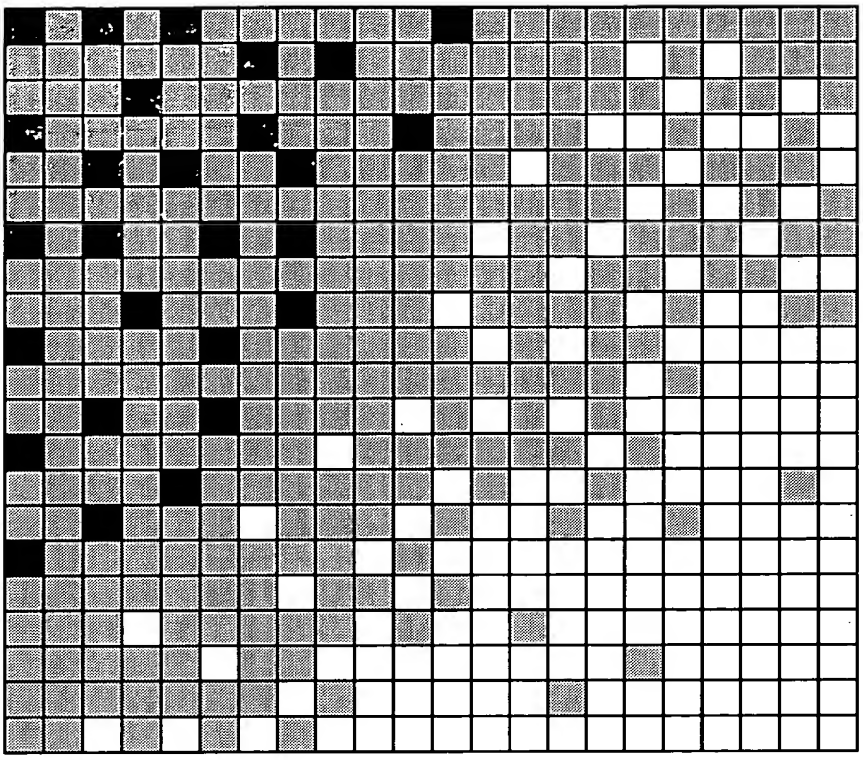
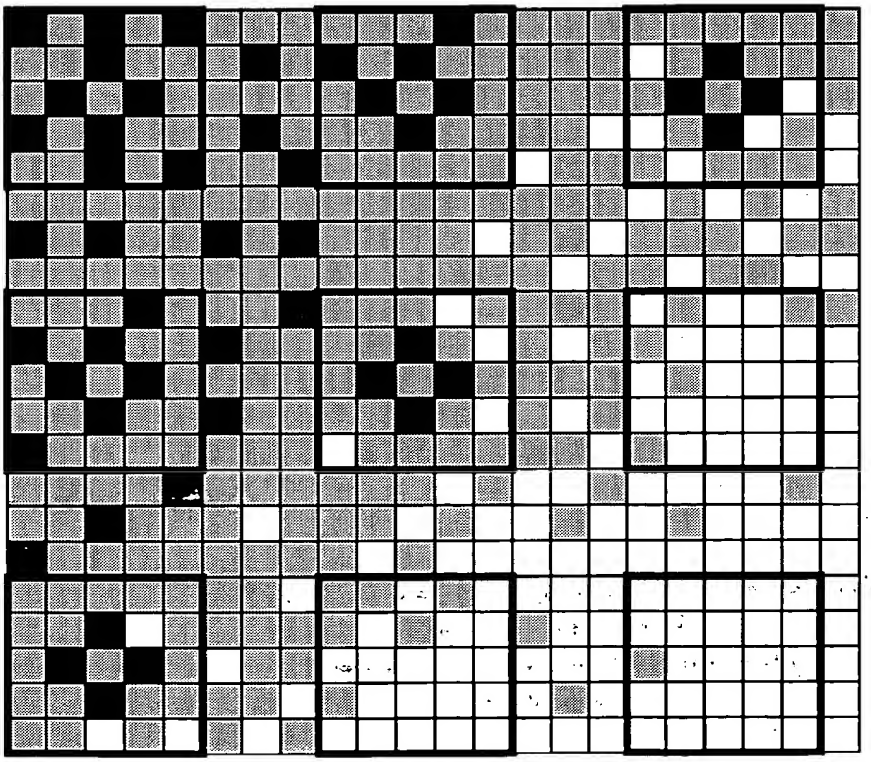


FIG. 74B

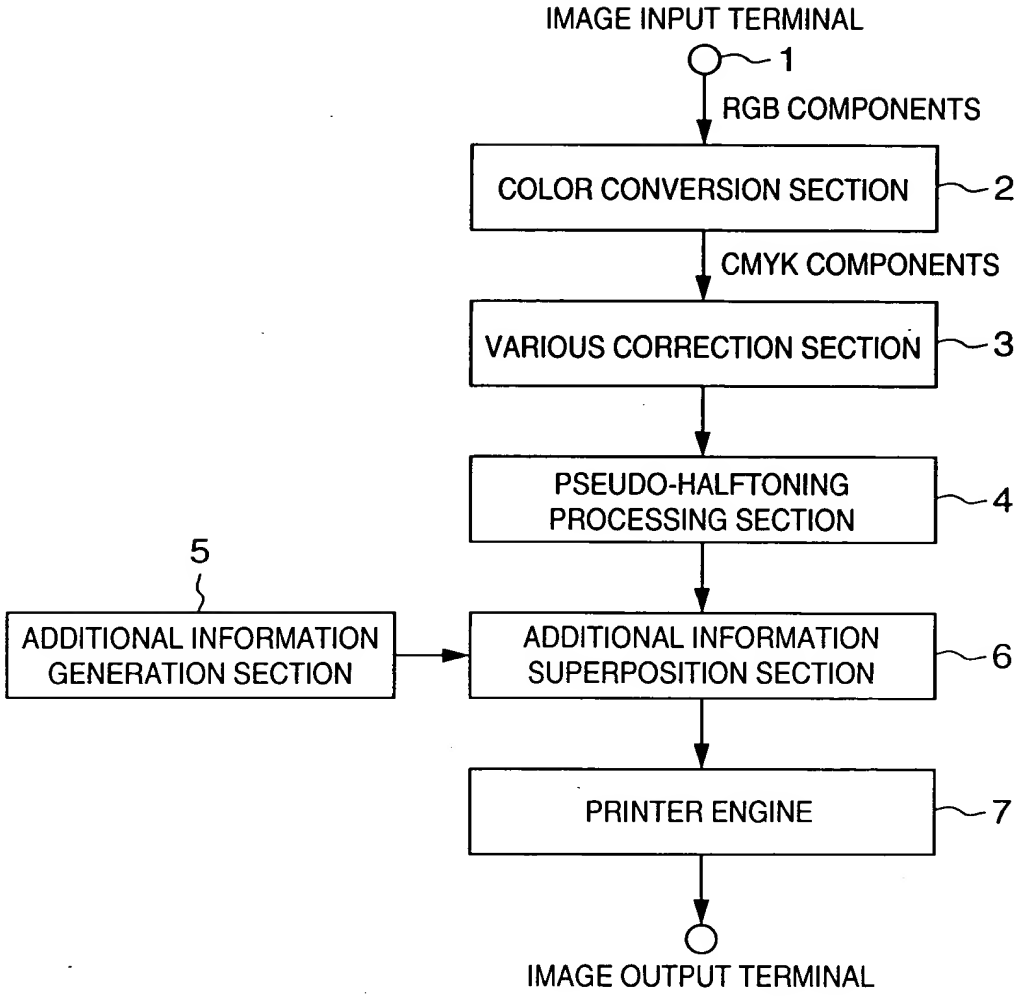
IMAGE AFTER DOT PATTERN ATTACHMENT

□ : DENSITY REFERENCE REGION (5-PIXEL SQUARE BLOCK)



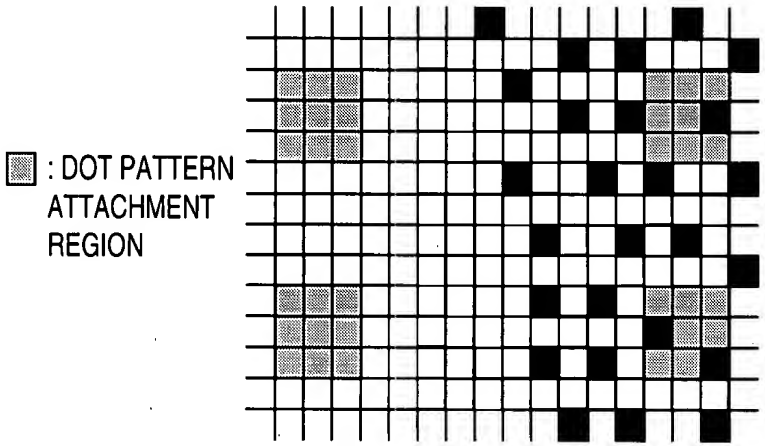
0960800 · 0923961 · 0960800

FIG. 75



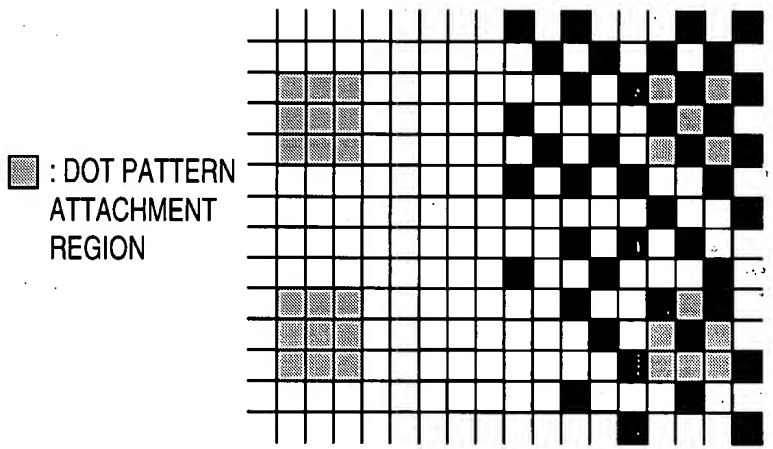
0067523.092800

FIG. 76A



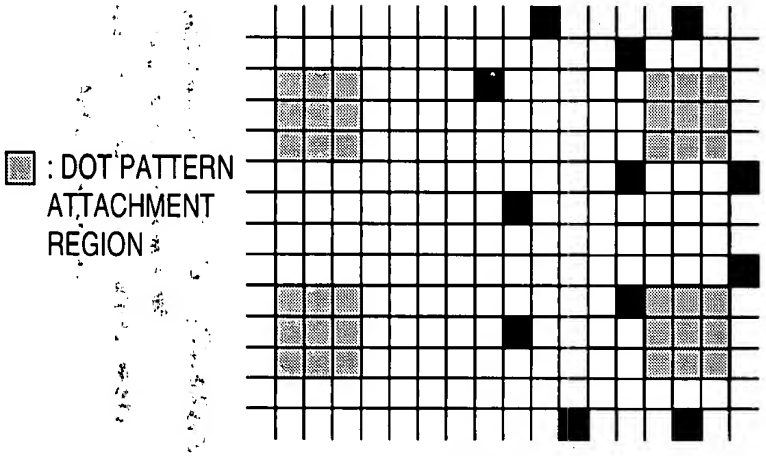
CYAN PLANE

FIG. 76B



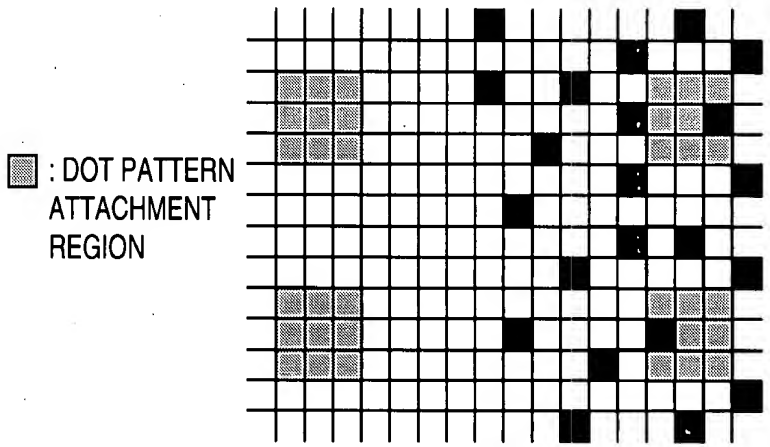
MAGENTA PLANE

FIG. 76C



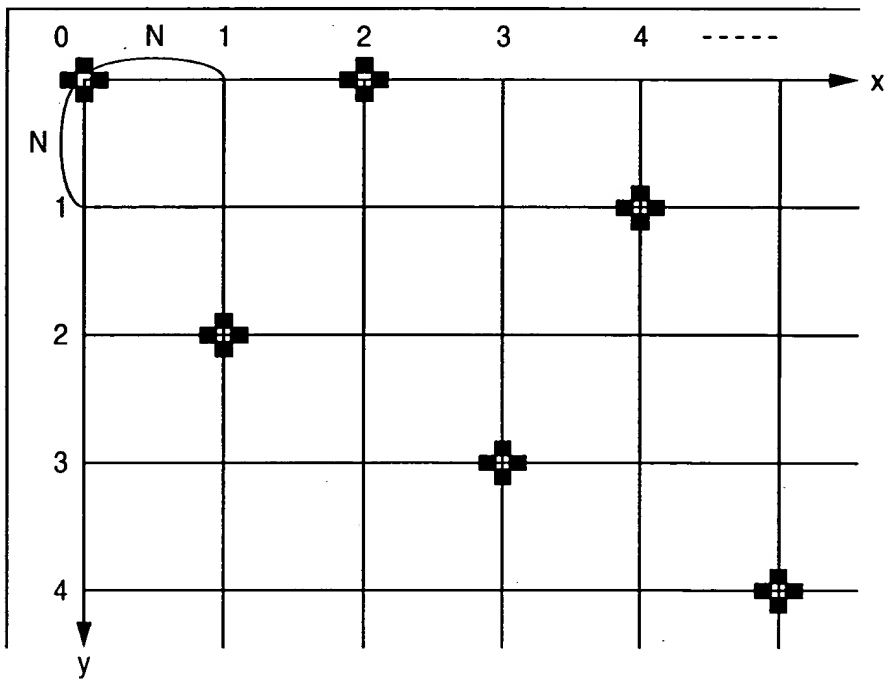
BLACK PLANE

FIG. 76D



YELLOW PLANE

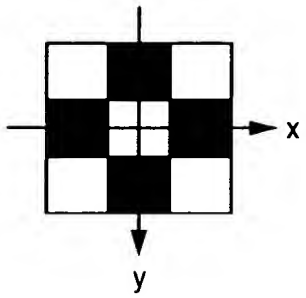
FIG. 77



MATRIX INTERVAL	N
NUMBER z	ATTACHMENT POSITION (Lx^z, Ly^z)
1	(0, 0)
2	(2, 0)
3	(4, 1)
⋮	⋮
z	(Lx^z, Ly^z)

0098023.0962967

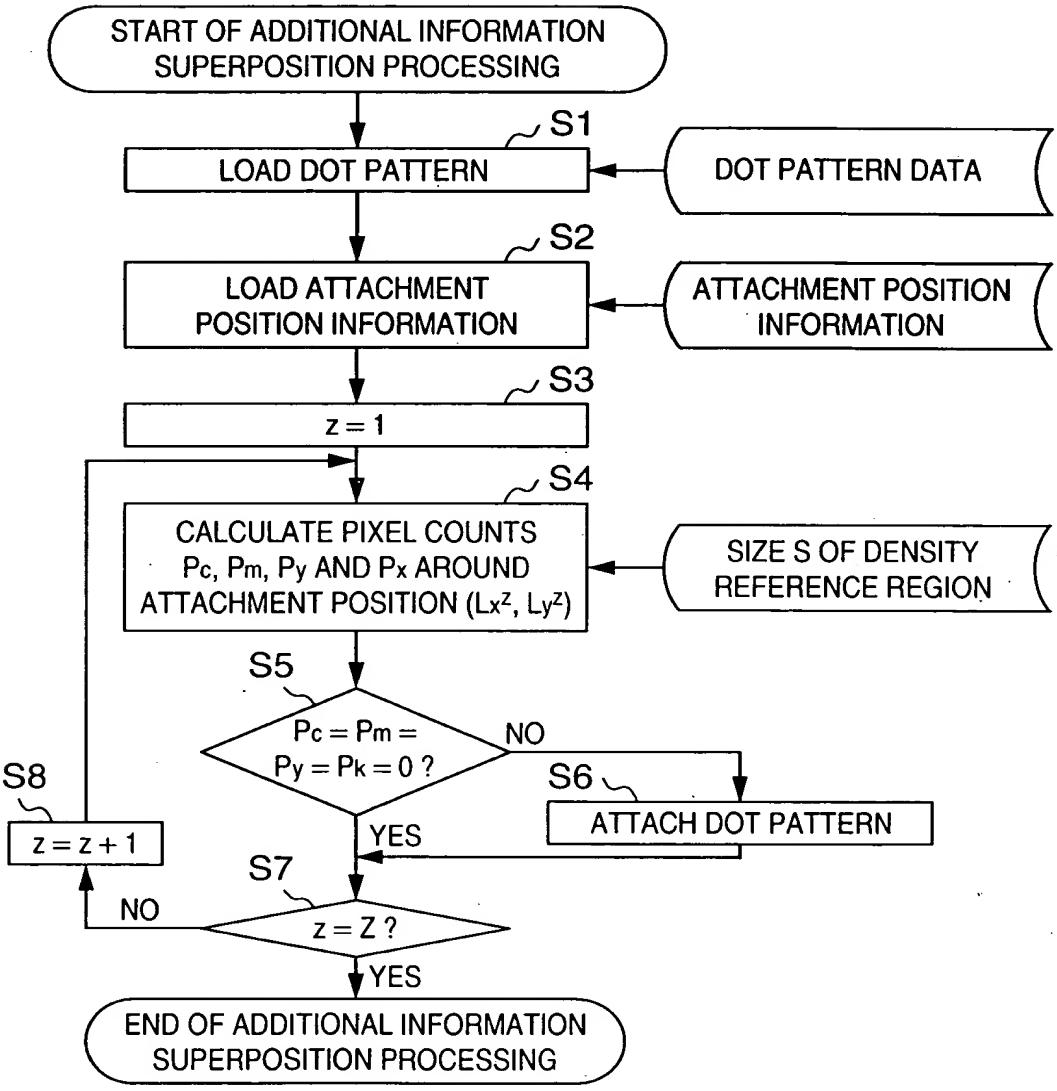
FIG. 78



PIXEL COUNT C OF PATTERN	4
NUMBER c	PIXEL POSITION (Px, Py)
1	(1, 0)
2	(0, –1)
3	(–1, 0)
4	(0, –1)

0960726.0928030

FIG. 79



0082609 : 2297950

FIG. 80A

CYAN PLANE

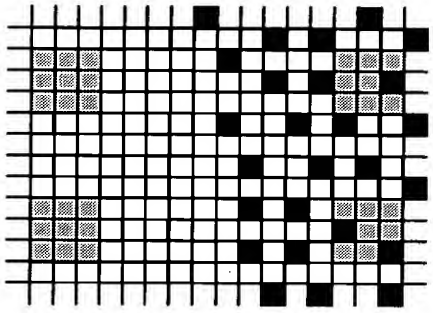


FIG. 80B

MAGENTA PLANE

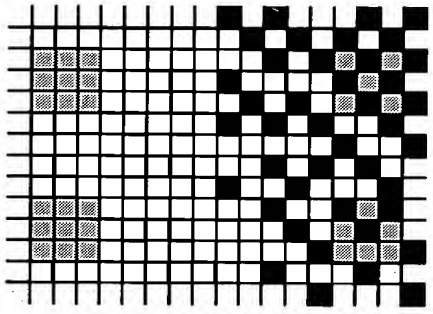


FIG. 80C

BLACK PLANE

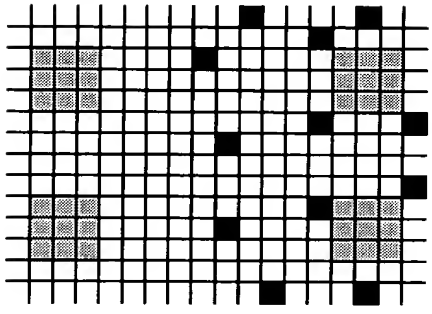
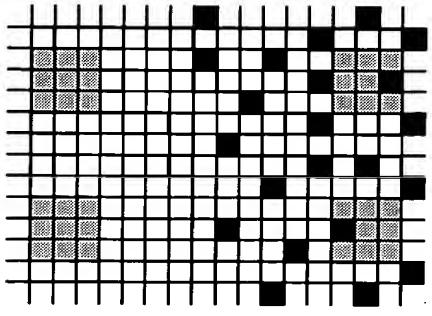


FIG. 80D

YELLOW PLANE



: DENSITY REFERENCE REGION
(3-PIXEL SQUARE BLOCK)

0096723 · 0928000

FIG. 81A

CYAN PLANE

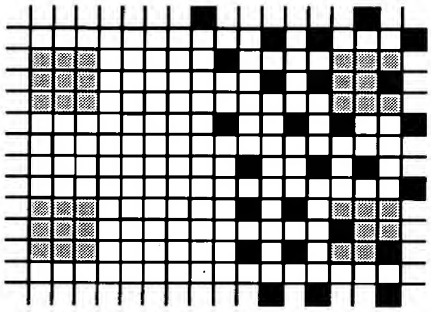


FIG. 81B

MAGENTA PLANE

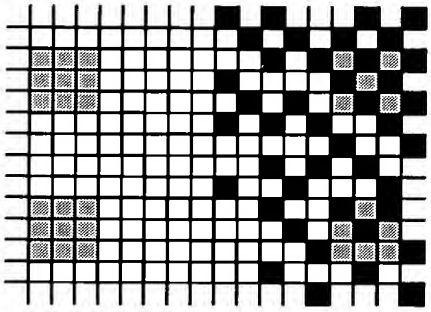


FIG. 81C

BLACK PLANE

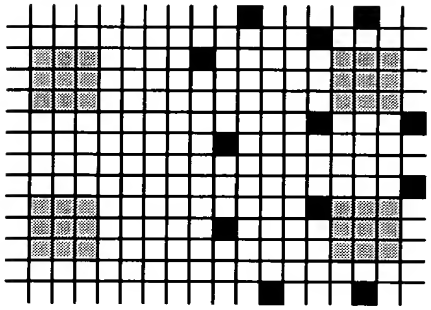
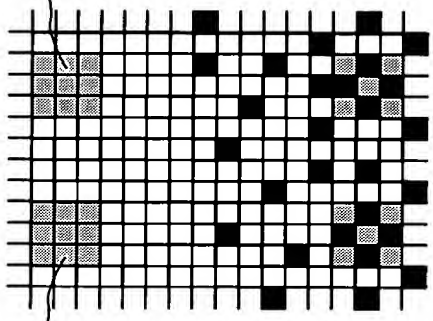


FIG. 81D

REGION A

YELLOW PLANE



REGION B

0082609 · 2961516

FIG. 82A

CYAN PLANE

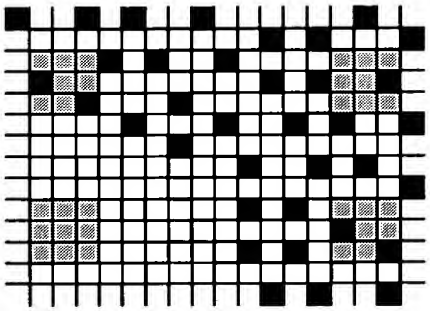


FIG. 82B

MAGENTA PLANE

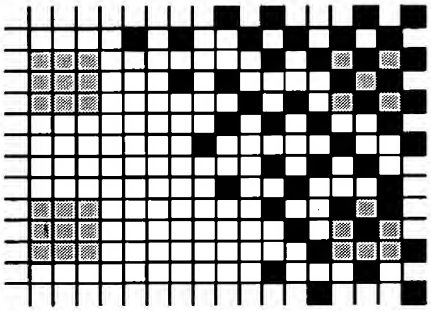


FIG. 82C

BLOCK PLANE

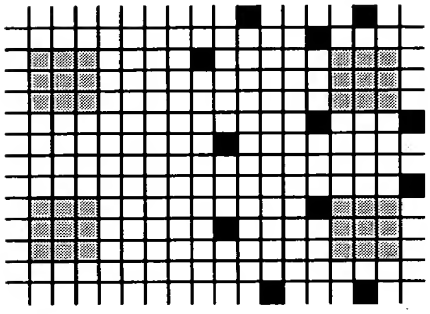
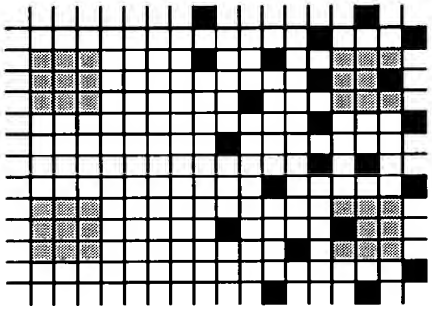


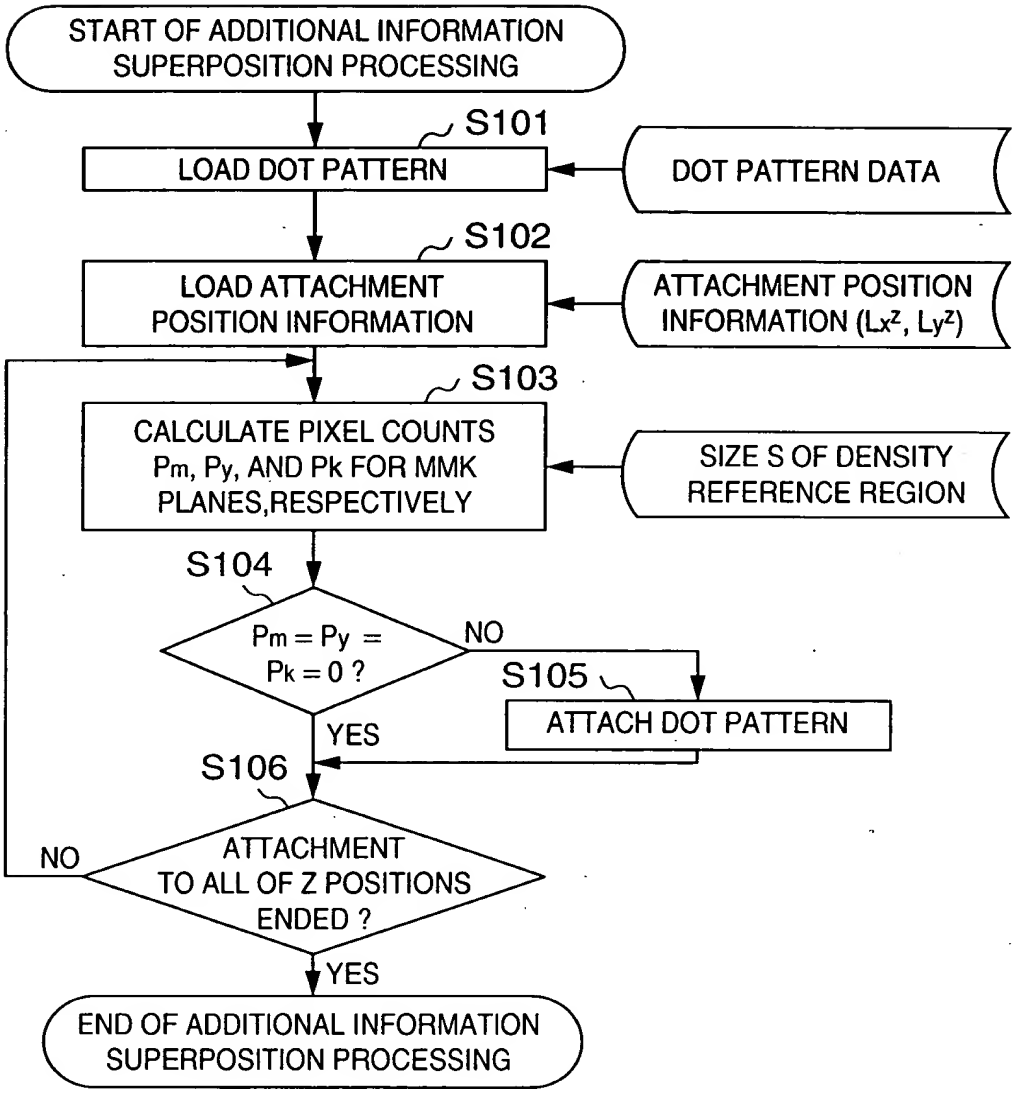
FIG. 82D

YELLOW PLANE



0082600 '09623951/960

FIG. 83



0082603 2297960

FIG. 84A

CYAN PLANE

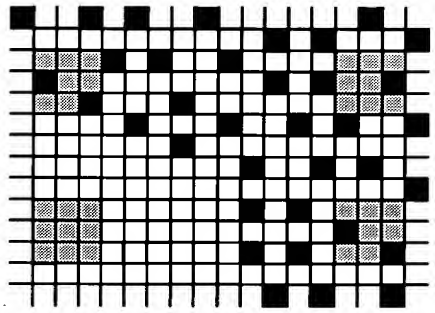


FIG. 84B

MAGENTA PLANE

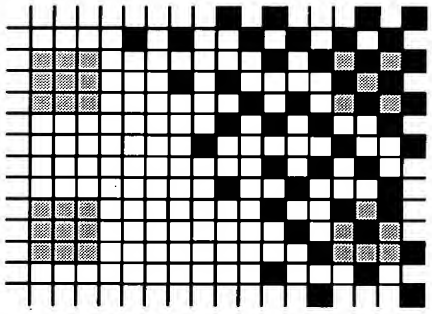


FIG. 84C

BLACK PLANE

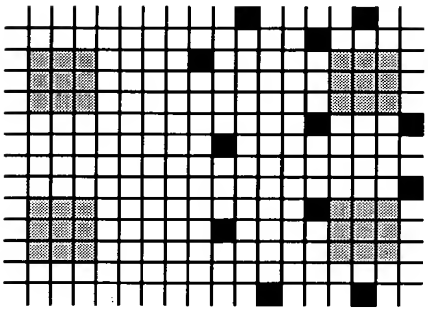
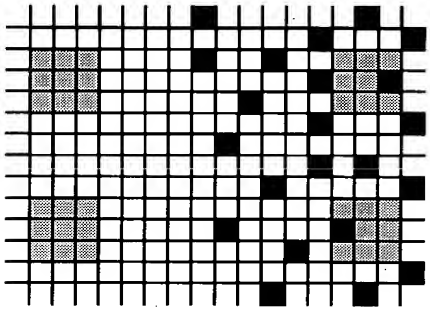


FIG. 84D

YELLOW PLANE



: DENSITY REFERENCE REGION
(3-PIXEL SQUARE BLOCK)

0082800.0967163.3

0082601 EP 1 659 760

FIG. 85A

CYAN PLANE

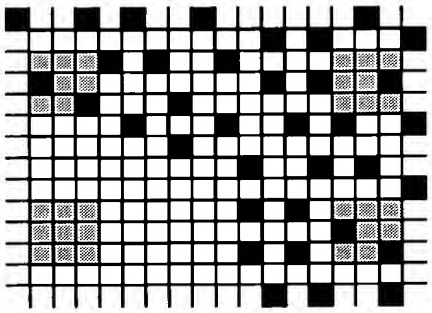


FIG. 85B

MAGENTA PLANE

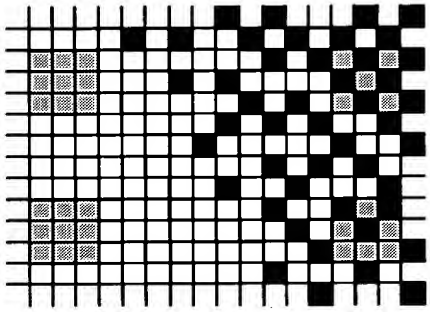


FIG. 85C

BLACK PLANE

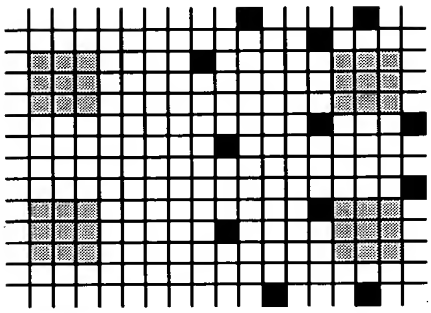
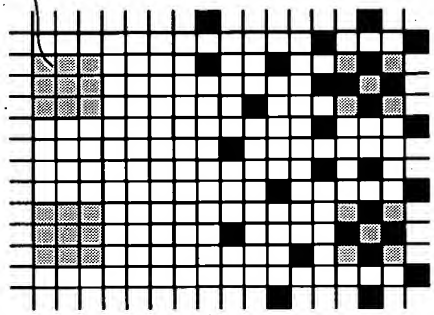


FIG. 85D

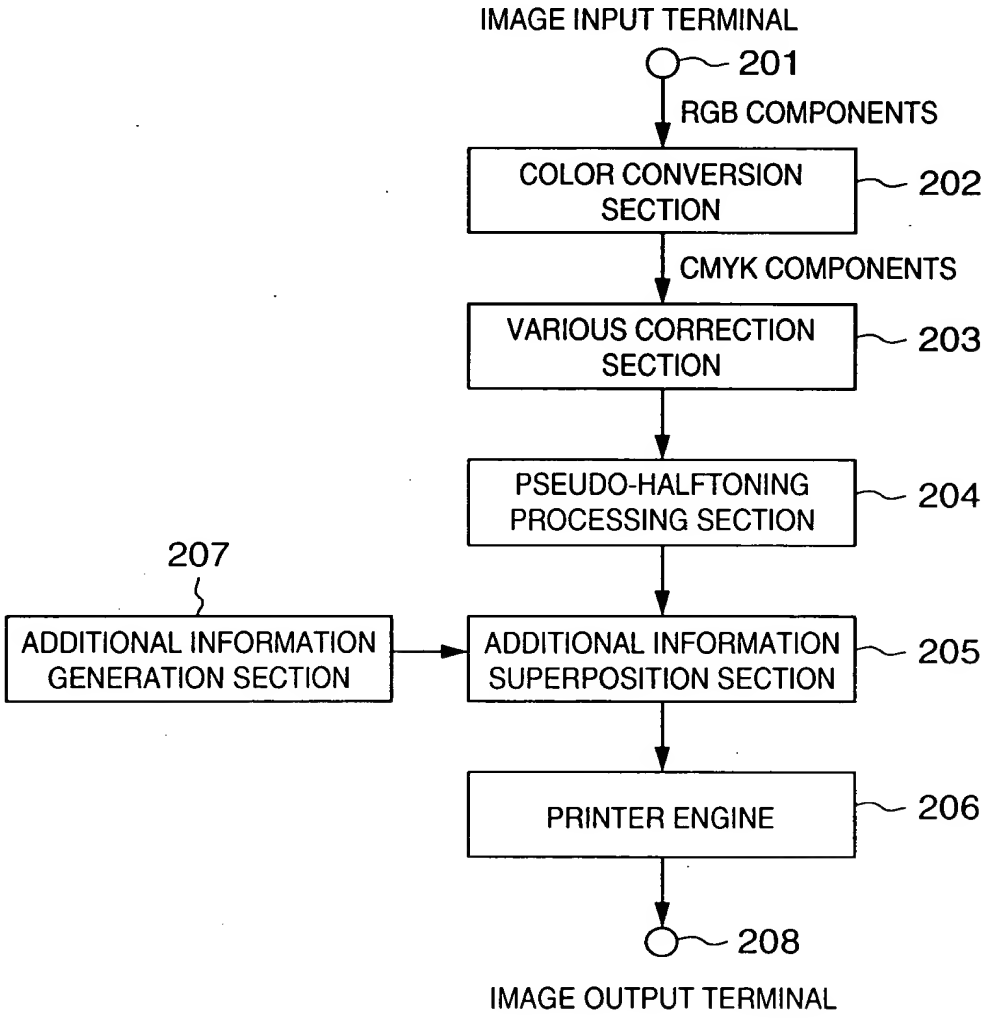
REGION A

YELLOW PLANE



: DOT PATTERN ATTACHMENT REGION

FIG. 86



0082609 '6237196

FIG. 87

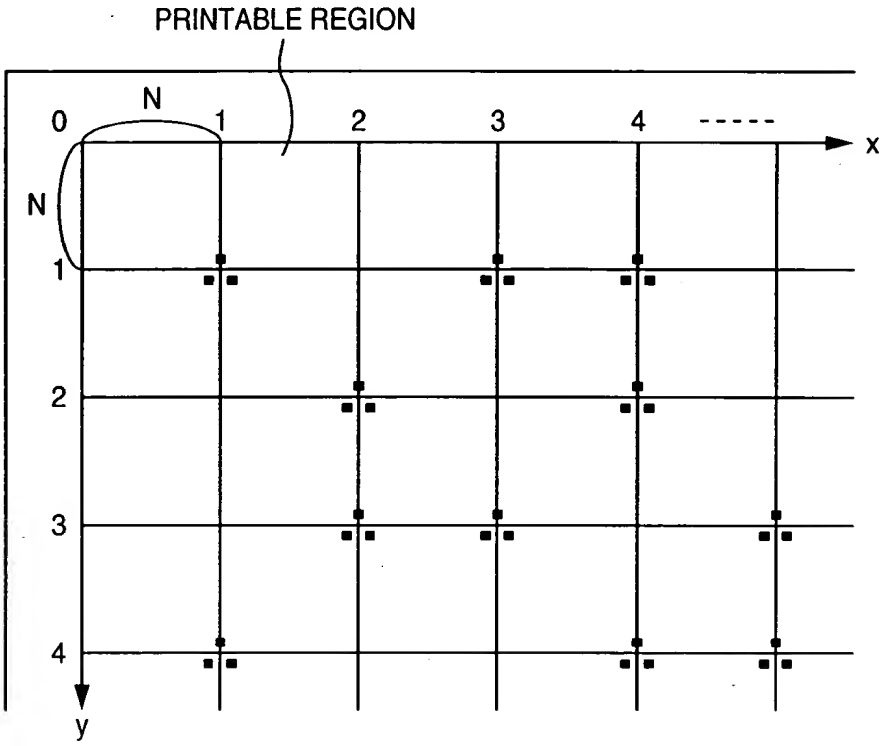


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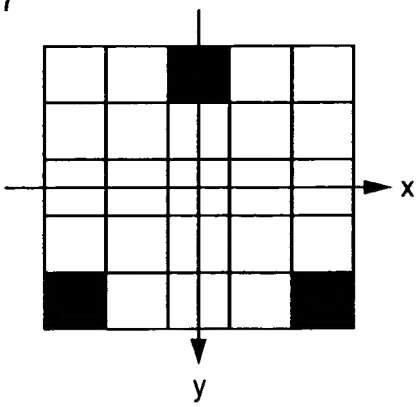
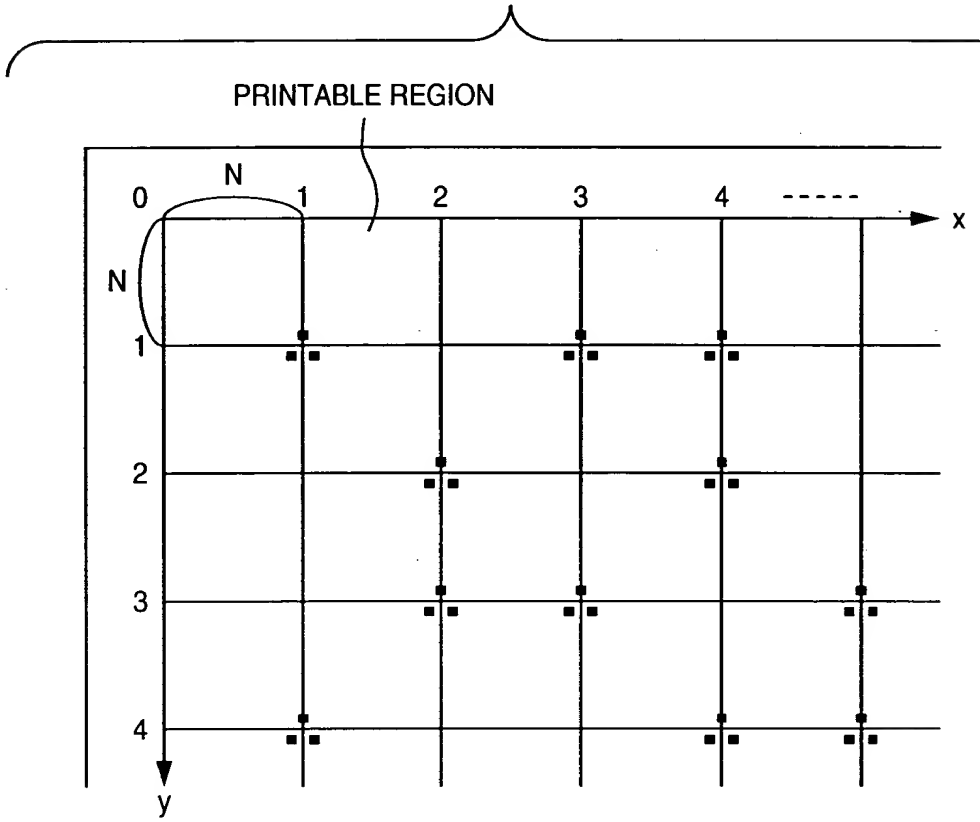
FIG. 88



PIXEL COUNT M OF PATTERN	4
NUMBER m	PIXEL POSITION (Px^m, Py^m)
1	(0, –2)
2	(–2, 2)
3	(2, 2)

0082600 '6237196

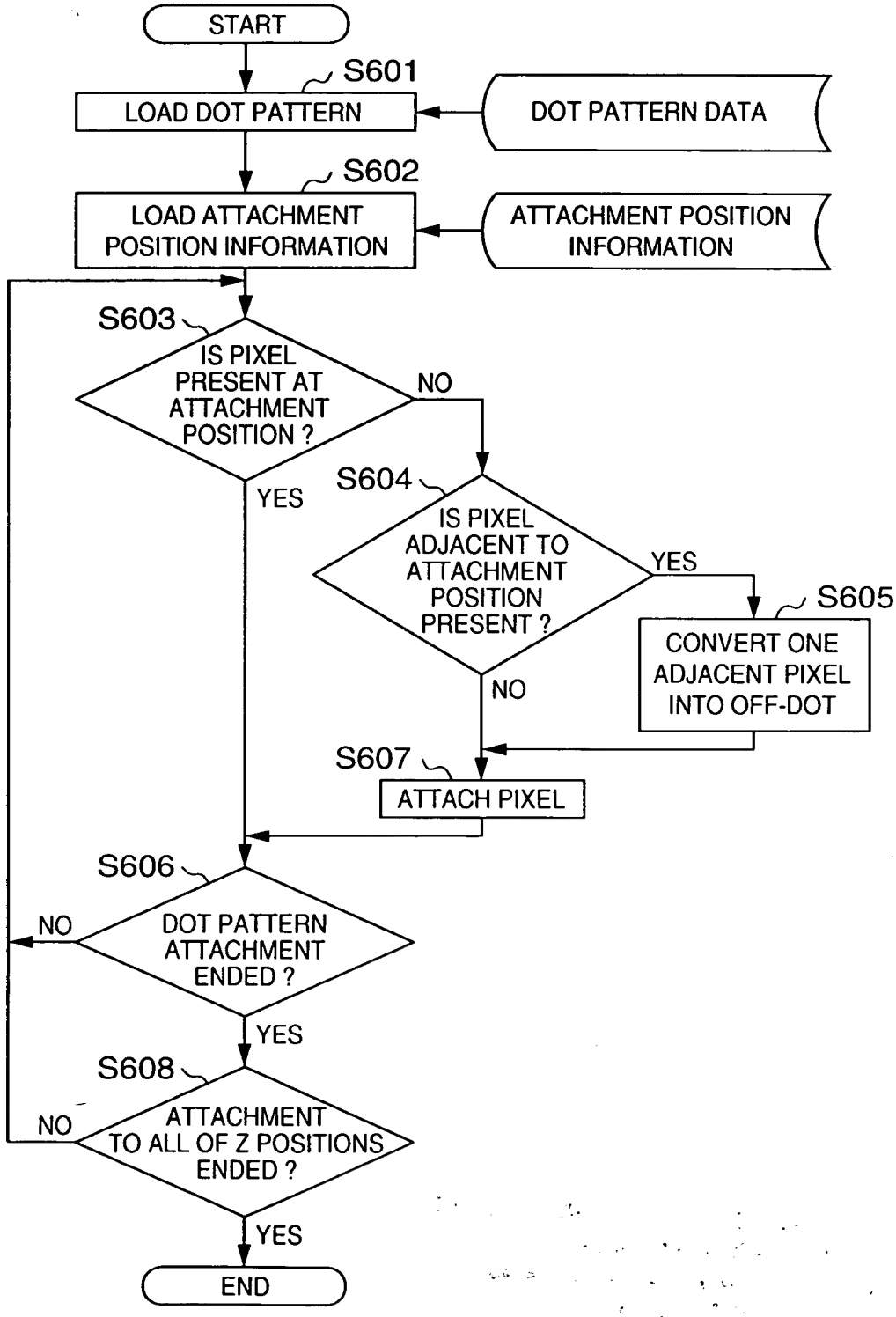
FIG. 89



MATRIX INTERVAL	N
NUMBER z	ATTACHMENT POSITION (Lx^z, Ly^z)
1	(1, 1)
2	(1, 3)
3	(1, 4)
⋮	⋮
z	(Lx^z, Ly^z)

0095716230 · 0080260

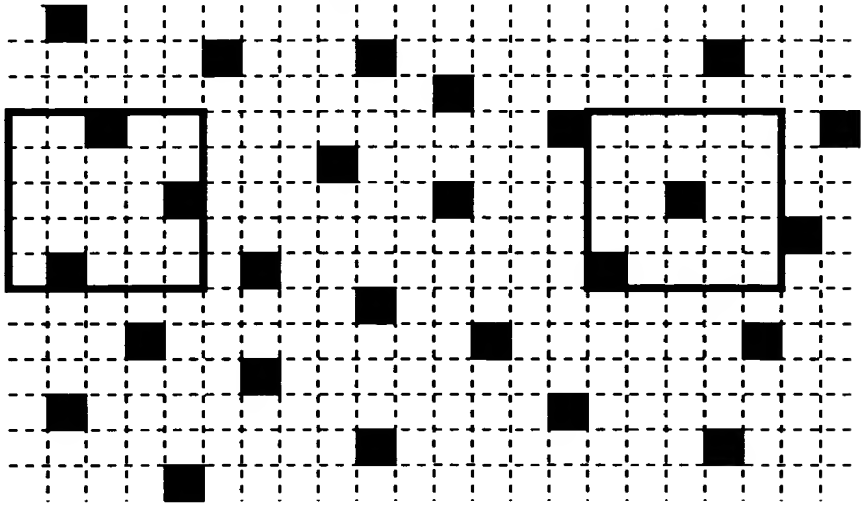
FIG. 90



0092800 - 0962316

FIG. 91A

IMAGE BEFORE DOT PATTERN ATTACHMENT

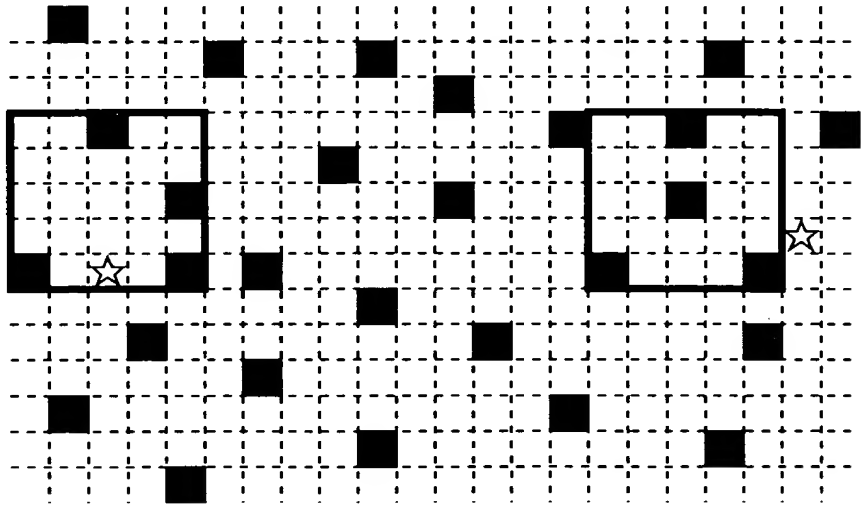


□ : DOT PATTERN ATTACHMENT REGION

0096/1623 09/28800

FIG. 91B

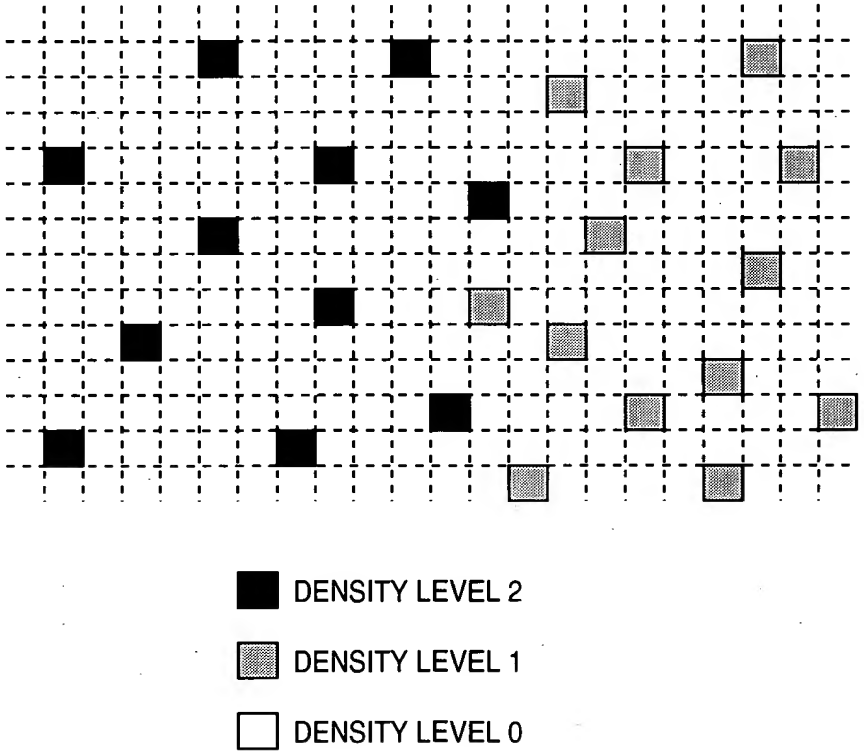
IMAGE AFTER DOT PATTERN ATTACHMENT



☆ : PIXEL CONVERTED INTO OFF-DOT

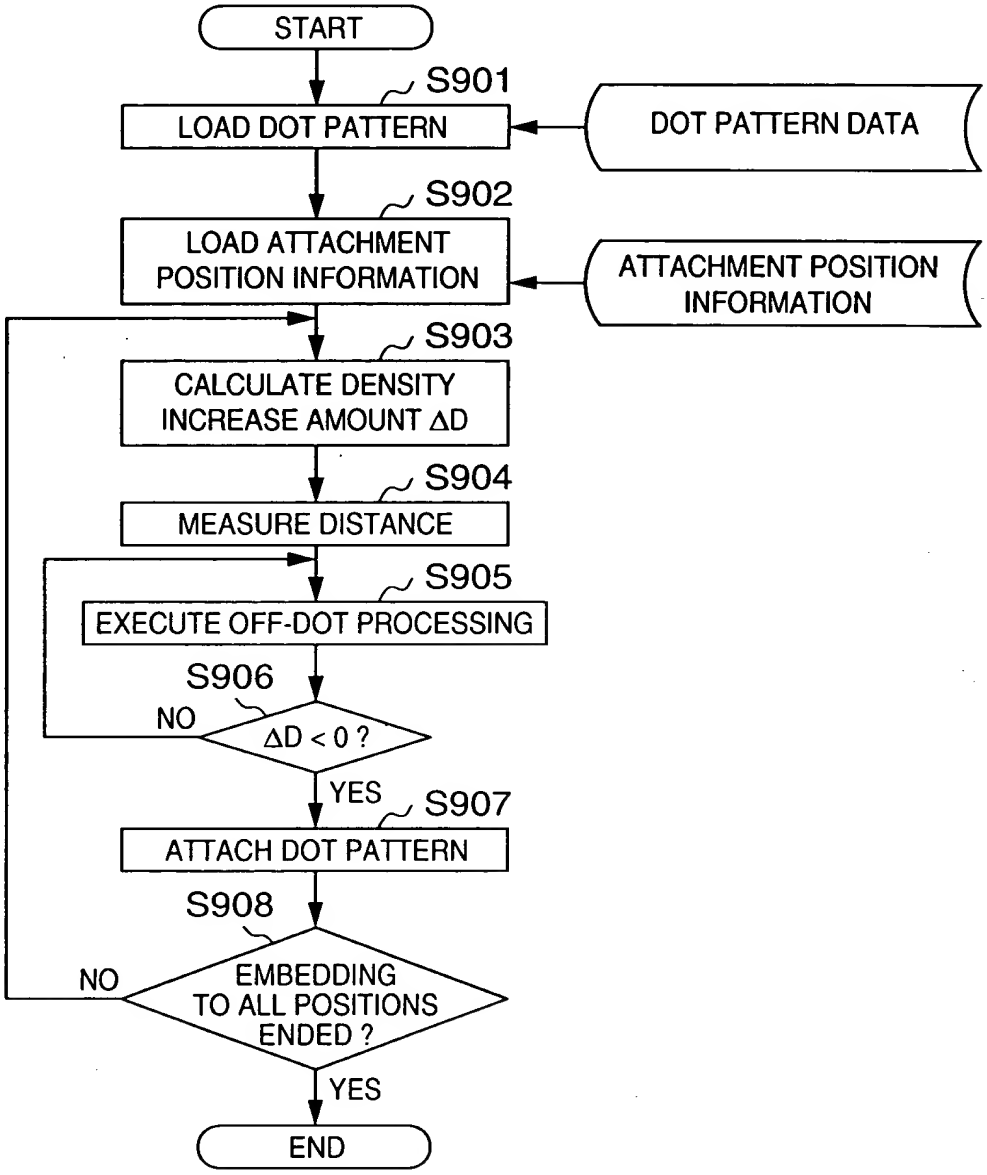
□ : DOT PATTERN ATTACHMENT REGION

FIG. 92



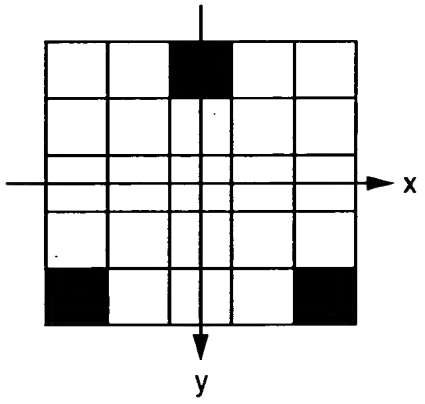
09671623.092800

FIG. 93



0080800 : 0960315

FIG. 94



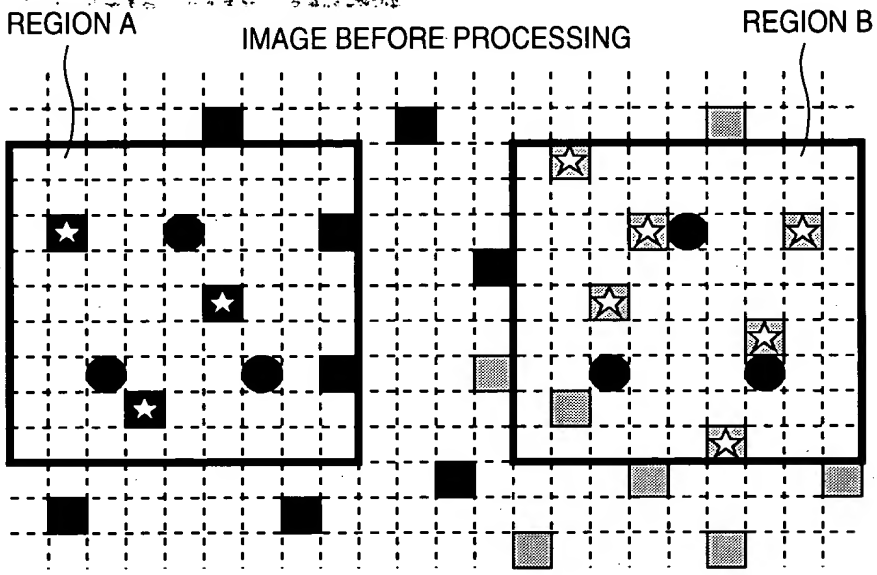
PIXEL COUNT M OF PATTERN	3
DENSITY LEVEL V	2
NUMBER m	PIXEL POSITION (P_x^m, P_y^m)
1	(0, –2)
2	(–2, 2)
3	(2, 2)

0095152 0095800

FIG. 95

: DENSITY STORAGE REGION
⊠: DOT PATTERN ATTACHMENT POSITION
N • Lx^z
N • Lx^z+1
x
y
N • Ly^z
Iy(x', y')
DISTANCE T
S PIXELS

FIG. 96A



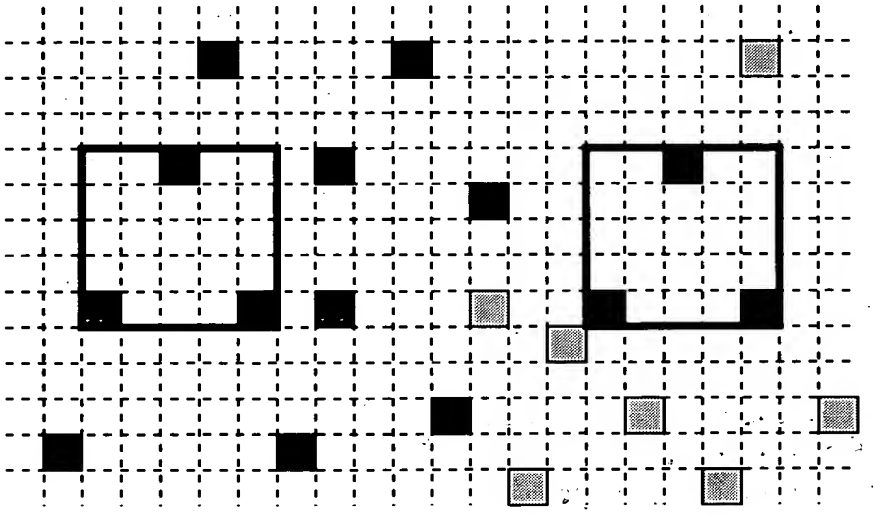
● : PIXEL OF DOT PATTERN

□ : DENSITY STORAGE REGION

☆ : PIXEL TO BE CONVERTED INTO OFF-DOT

FIG. 96B

IMAGE AFTER PROCESSING

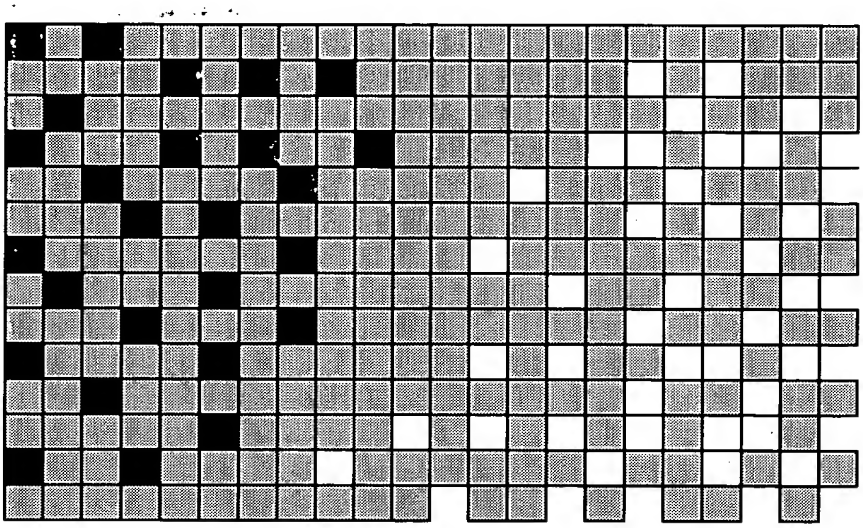


□ : DOT PATTERN ATTACHMENT REGION

●　　●

0960231516 090800

FIG. 97



■ : DENSITY LEVEL 2

▒ : DENSITY LEVEL 1

□ : DENSITY LEVEL 0

09671623.092800

FIG. 98

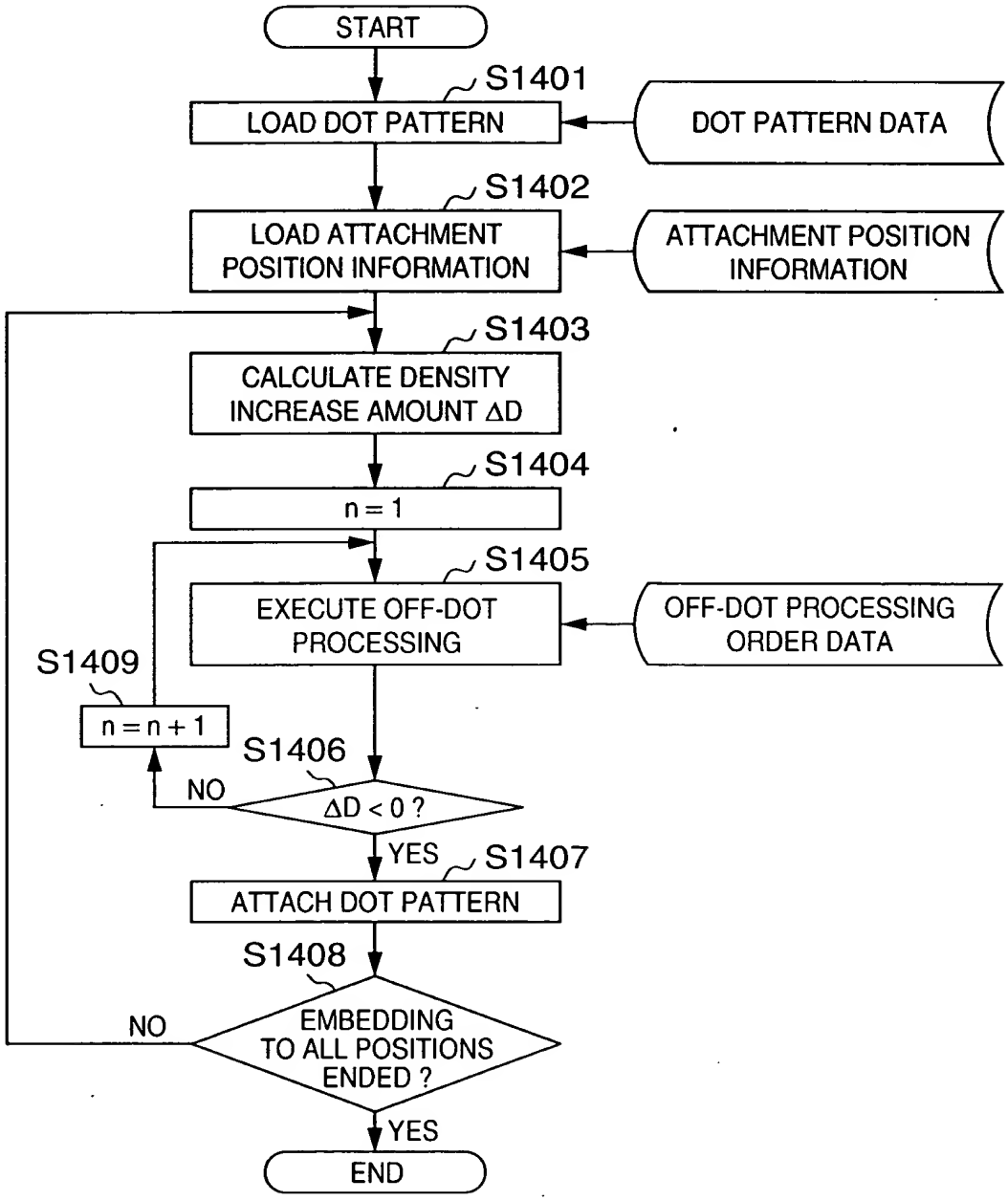
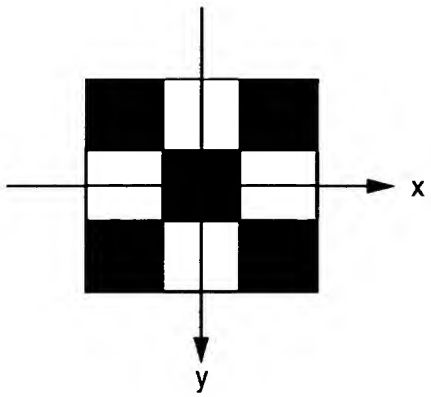

START
S1401
LOAD DOT PATTERN
DOT PATTERN DATA
S1402
LOAD ATTACHMENT POSITION INFORMATION
ATTACHMENT POSITION INFORMATION
S1403
CALCULATE DENSITY INCREASE AMOUNT ΔD
S1404
n = 1
S1405
EXECUTE OFF-DOT PROCESSING
OFF-DOT PROCESSING ORDER DATA
S1409
n = n + 1
S1406
NO
ΔD < 0 ?
YES
S1407
ATTACH DOT PATTERN
S1408
NO
EMBEDDING TO ALL POSITIONS ENDED ?
YES
END

FIG. 99



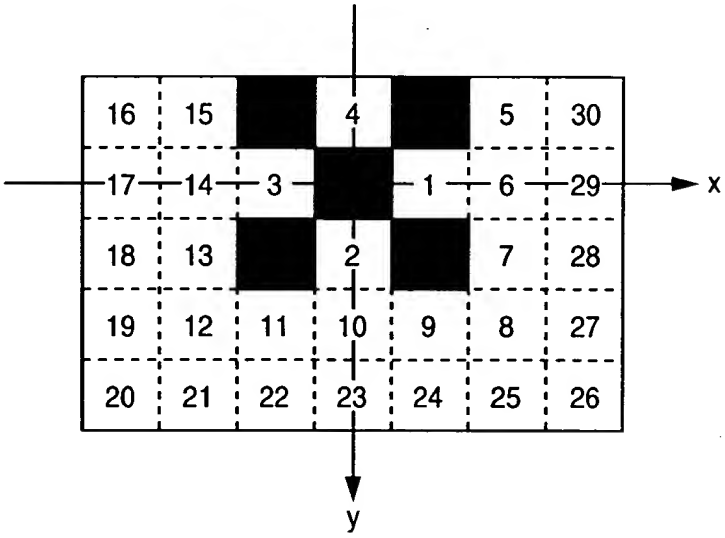
09/763,800 02/26/2001

FIG. 100

PIXEL COUNT M OF PATTERN	5
DENSITY LEVEL V	2
NUMBER m	PIXEL POSITION (Px^m, Px^m)
1	(0, 0)
2	(1, 1)
3	(1, –1)
4	(–1, 1)
5	(–1, –1)

0090600.0952359

FIG. 101



0096/15923 .0980800

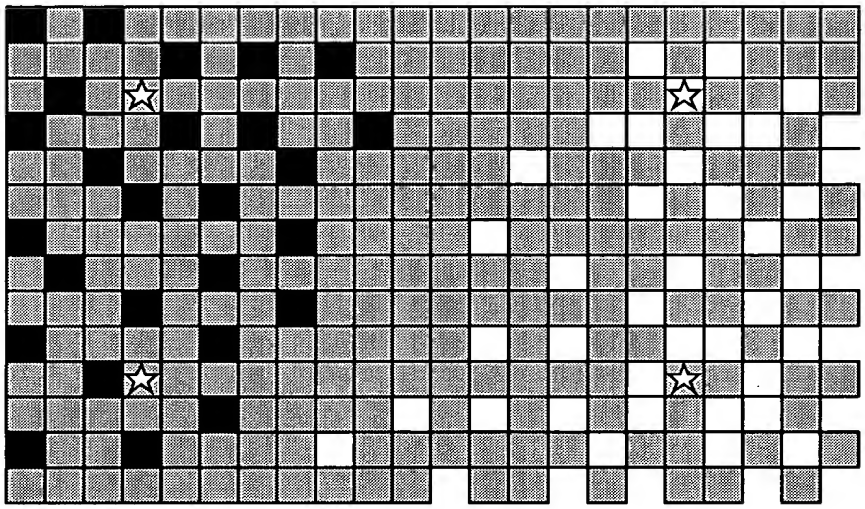
FIG. 102

NUMBER n	COORDINATES (Rx^n, Ry^n)
1	(1, 0)
2	(0, 1)
3	(−1, 0)
4	(0, −1)
⋮	⋮
30	(3, −1)

0967162 3.092800

FIG. 103A

BEFORE PROCESSING



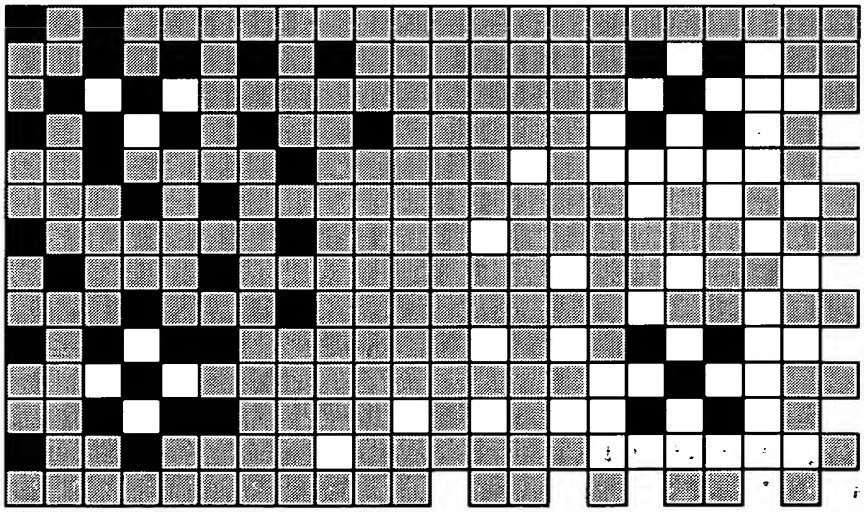
: DENSITY LEVEL 1

: DENSITY LEVEL 2

☆ : DOT PATTERN ATTACHMENT POSITION

FIG. 103B

AFTER PROCESSING



: DENSITY LEVEL 1

: DENSITY LEVEL 2

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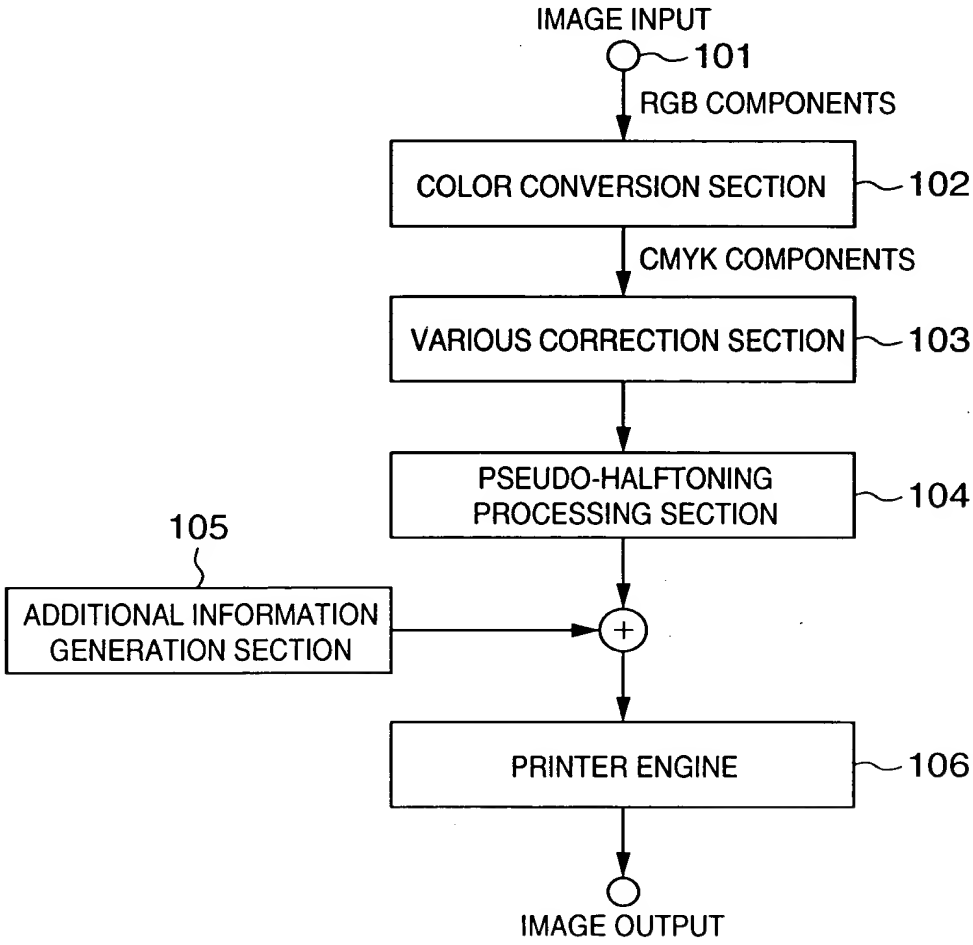
FIG. 104



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096/7362 3.092800

FIG. 105

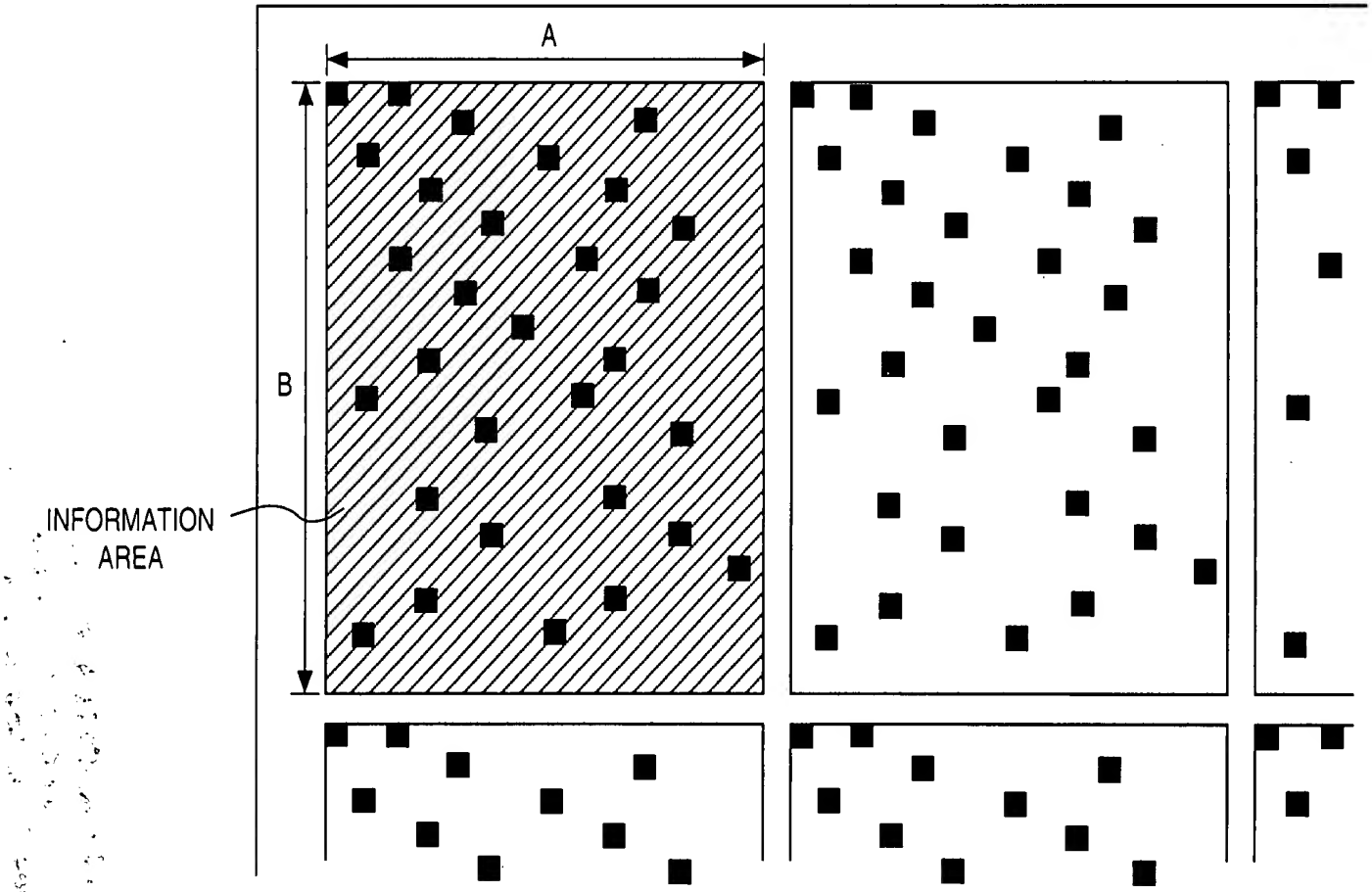


FIG. 106

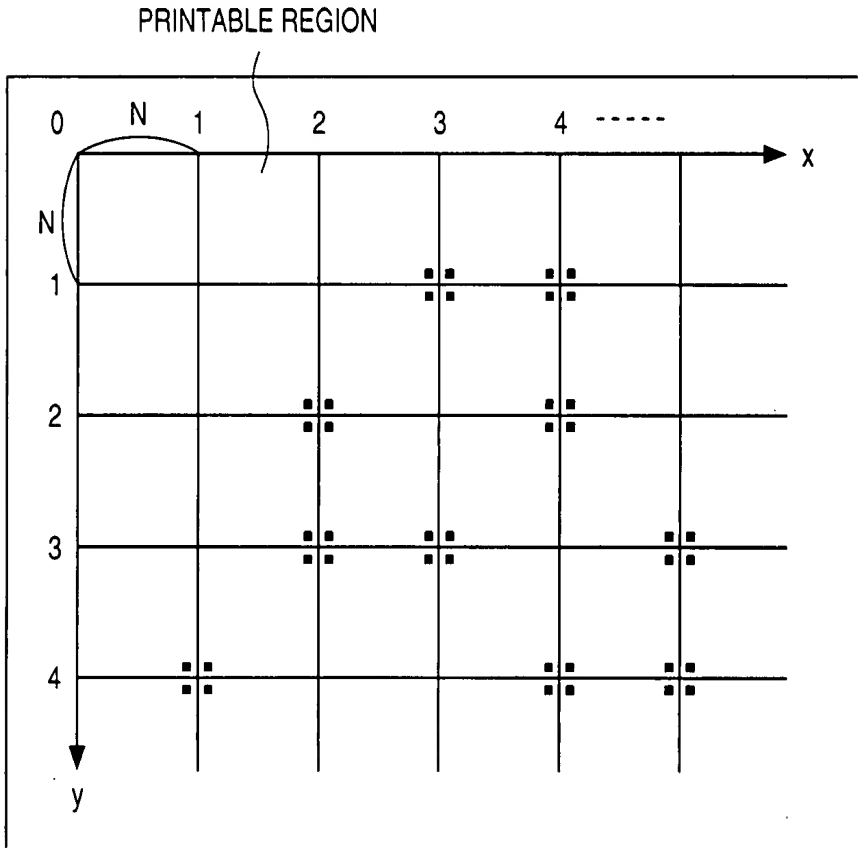
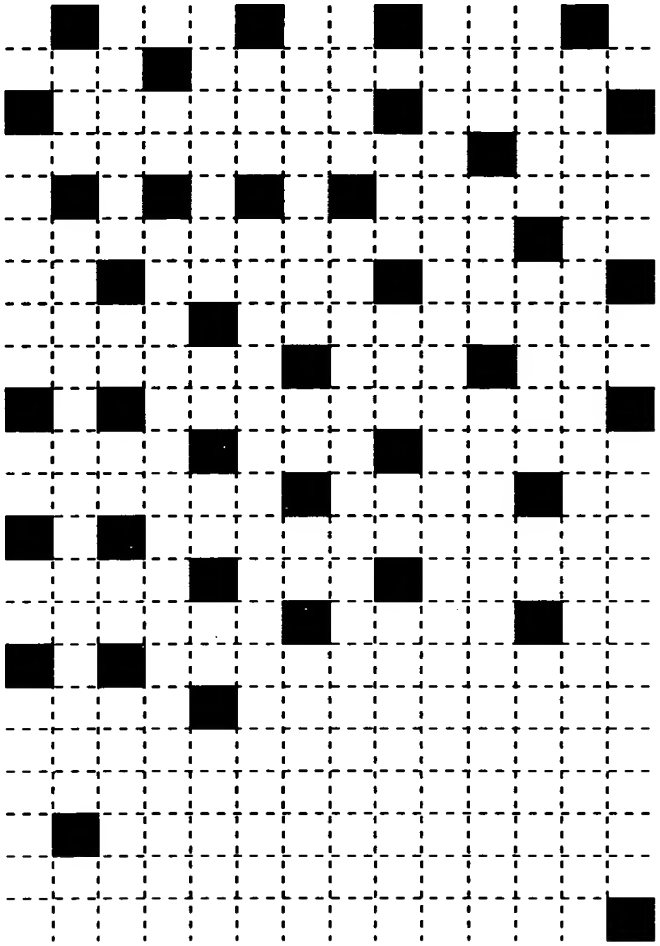
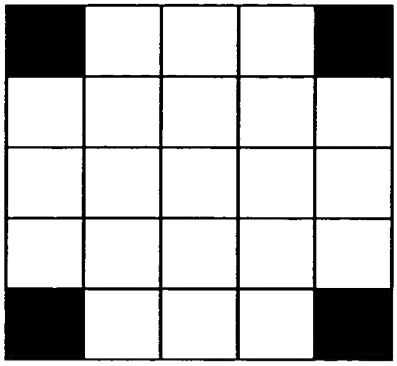


FIG. 107



09671523.062800

FIG. 108



0057162300928D0

FIG. 109

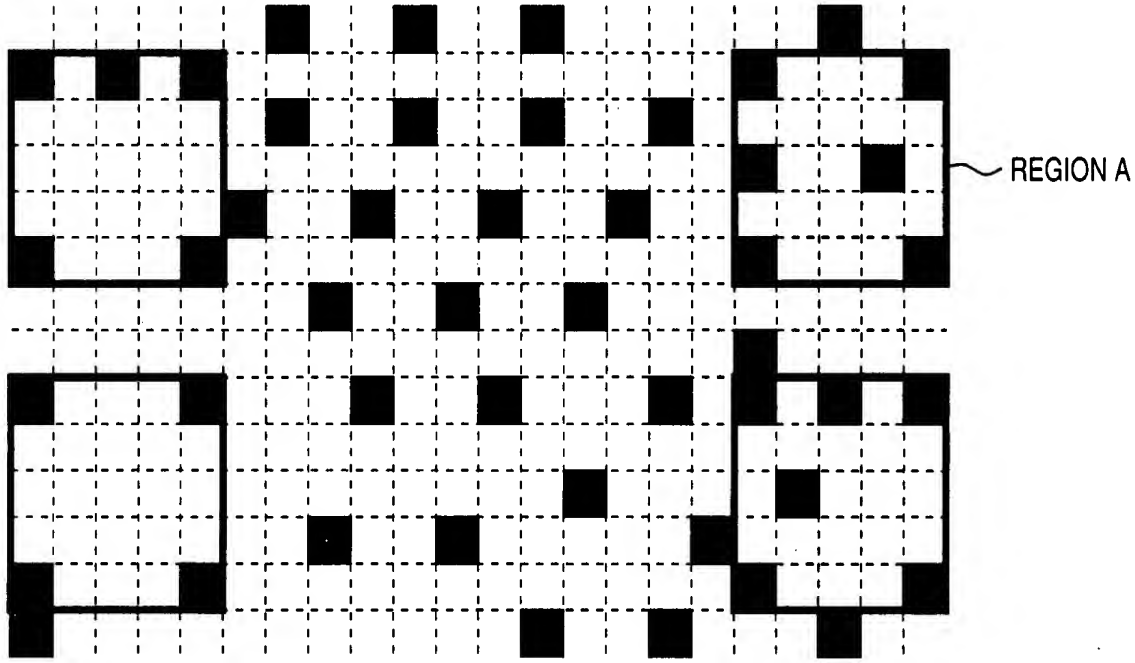
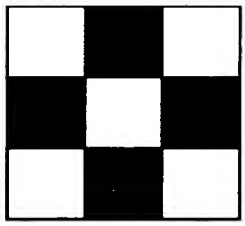


FIG. 110

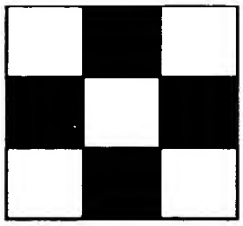


09623800.09627596

FIG. 111

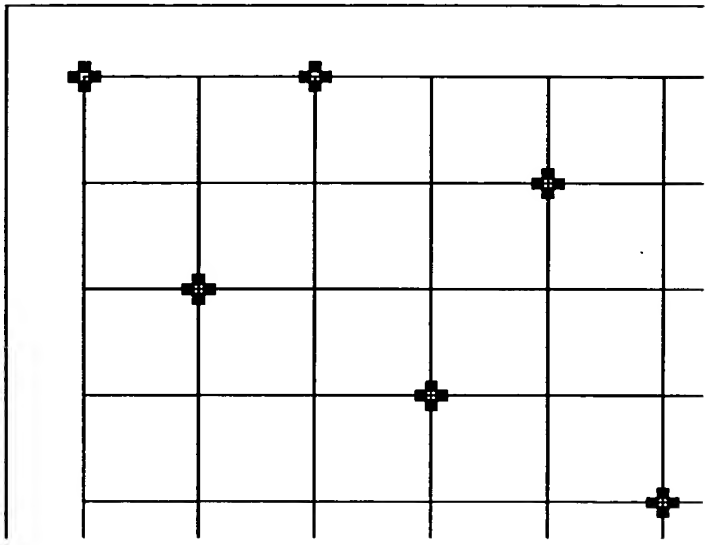
09957523 .092800

FIG. 112



0096231960 - 0080800

FIG. 113



0098260 "EP9657960

FIG. 114A

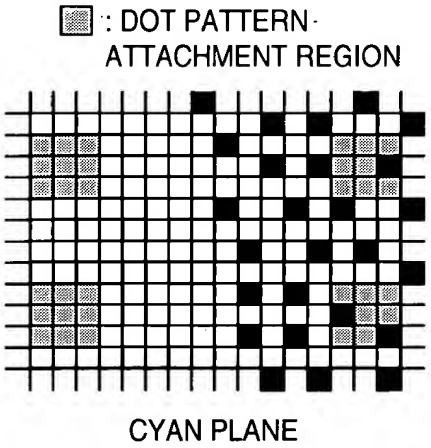


FIG. 114B

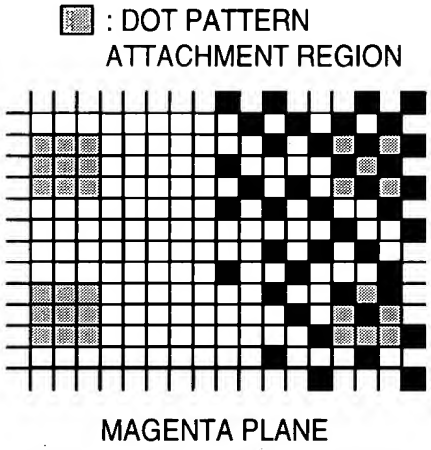


FIG. 114C

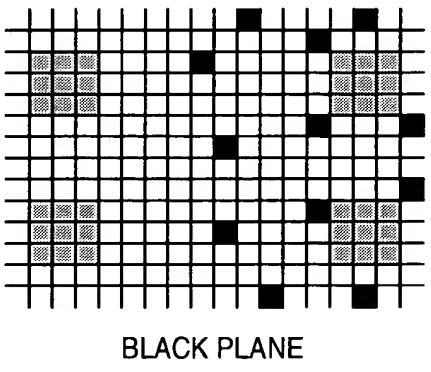
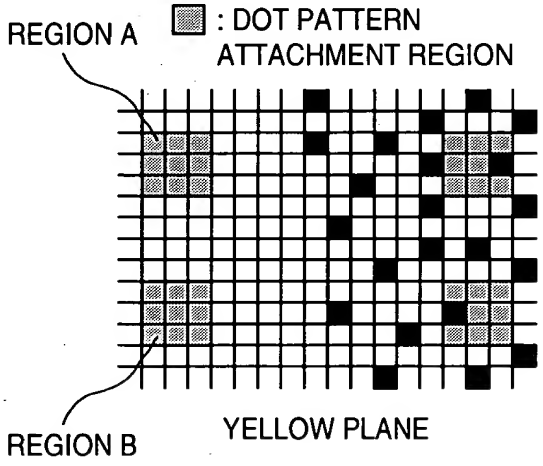
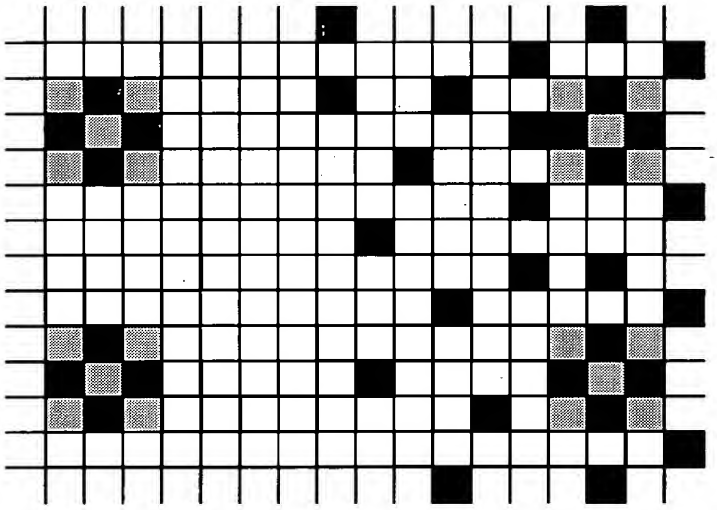


FIG. 114D



0098023 09821800

FIG. 115



0082600 E291960